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# PRODUCTION METHODS FROM THE LOCOMOBILE FACTORY

## MACHINE FIXTURES AND A STOCK SYSTEM THAT FACILITATE THE MANUFACTURE OF A HIGH-GRADE MOTOR CAR

BY CHESTER L. LUCAS*

AT the factory of the Locomobile Co. of America in Bridgeport, Conn.—the factory that turns out but four cars per day and prides itself on those four—there are many creditable methods in use. In the following article, some of these methods are described.

One of the most striking operations that may be seen by a visitor to this factory is the milling of the sides of the crankshaft bearings in the engine cases. Fig. 1 gives a good idea of the way this operation is performed on a special Beaman & Smith milling machine. The milling of the sides of the crankshaft bearings—seven in number—and finishing them to size is done in one operation. This means that fourteen cutters are required; these are shown in detail on the arbor of the machine in Fig. 2. It will be noticed that these cutters are of the side-milling type, and are made with inserted blades of "Novo" steel. The location of these cutters upon the arbor is, of course, a very important feature, as their position governs the distance at which the milling cuts are made. The cutters are located approximately on the arbor by means of collars of the right thickness. As they must frequently be removed for grinding, however, it is necessary to have individual adjustment to make up for the amount lost in grinding, etc. To take care of this, the cutters are made after the manner illustrated in Fig. 3, so that after they have been spaced approximately, the adjusting screws may be changed in order to slip the outer section of the cutter to one side or the other to make up the desired minute adjustment. There are six of these adjusting screws, three on a side, as illustrated. The section in the lower left-hand corner shows how the adjustment is made possible. The core of the cutter is indicated at *A* and the outer section at *B*. The hollow set-screw *C* has a tapered head that bears against the corresponding surface on section *B* and thus draws the sections together. For moving the outer section in the other direction, the three screws on the opposite side are used, first, however, loosening the other set. Fig. 1 illustrates the manner in which this milling is done. The engine case, which is of government bronze, comes to the milling machine with the caps loosely bolted in place. The operator inserts steel plugs in the bearings and clamps the caps upon them. There is, of course, plenty of room at the ends of the plugs to allow the milling cutters to pass. By clamping the plugs in place in the bearings, it is insured that the bearings will not be distorted by the milling. With the assistance of a crane hoist, the engine case is raised and placed in position on the inclined fixture on the table of the milling machine. In order to locate it properly, pins are placed in the cam-shaft bearing holes and these rest against stops on the fixture on the milling machine. After the engine case has been located on the fixture, and clamped in position by draw-bolts, which may be seen on the under side of the fixture, one feeding of the cutters across the work completes the milling. It takes about forty minutes to place

* Associate Editor of MACHINERY.

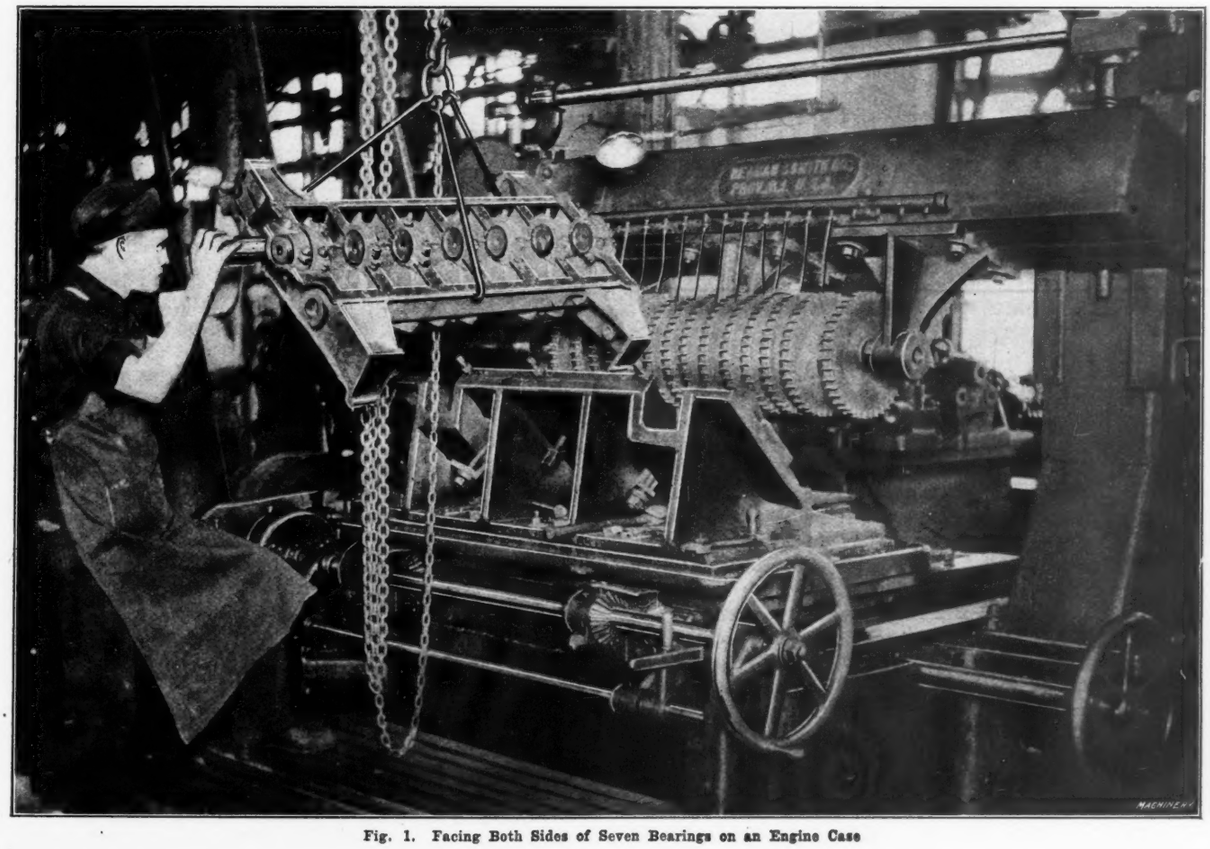

Fig. 1. Facing Both Sides of Seven Bearings on an Engine Case

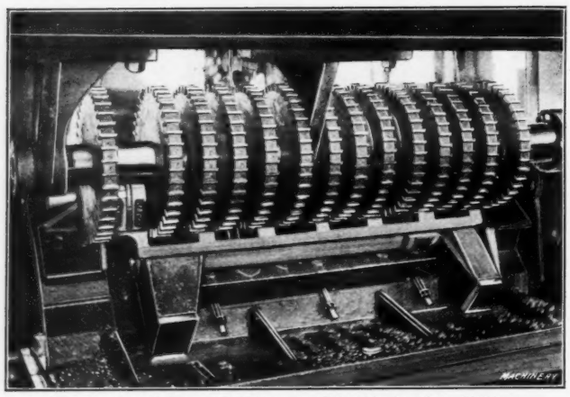

Fig. 2. Detail View of Cutters used for Engine Case Milling

the work in the fixture and perform these operations. From each bearing end, 3/16 inch of metal is removed by the milling.

Connecting-rod milling, a familiar operation in any motor building shop, is handled at the Locomobile factory in the manner illustrated in Fig. 4. The work is done on an ordinary horizontal milling machine, the two connecting-rods being clamped in position on the fixture, so that the small end of one rod is opposite the large end of the other. The fixture consists of the main casting *A* on which is the plate *B* which swivels about the center stud *C*. After one end of the pair of connecting-rods has been milled by the three face milling cutters on the arbor, pin *D* is removed and the fixture rotated so as to bring the opposite ends of the connecting-rods into

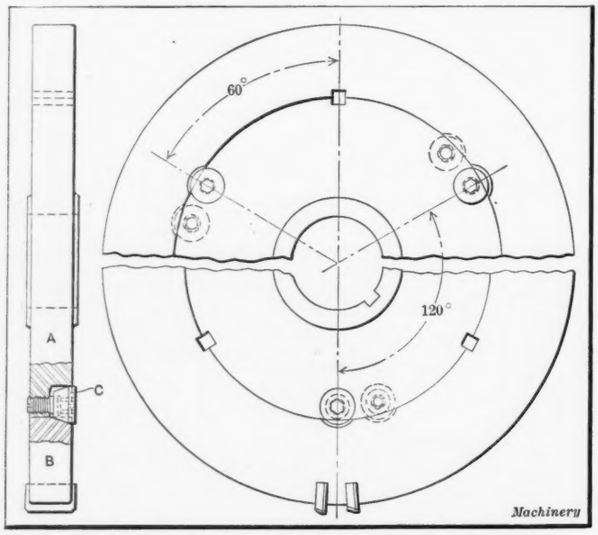


Fig. 3. Construction of One of the Adjustable Facing Cutters

the milling position. There is, of course, a corresponding hole in the opposite end of the fixture to locate it for the second operation. The clamping bolts are fitted with springs to keep the clamps in approximately the correct position when removing or replacing the work. The large ends of the rods are located under the hinge-clamp *F*, that is fulcrumed on pin *G* and bears on the work when set-screw *H* is tightened.

In the crankshaft turning department may be observed an interesting fixture for turning the cheeks of the different throws of a crankshaft. On a six-throw crankshaft, the rough-turning is done first, allowing the center-rest *A*, Fig. 5, to be applied. On the carriage of the lathe, at the front, is the fixture *B* that holds the fixed turning tools *C*, which are, in turn, dovetailed into slides in the blocks *D*. The turning tools are sharpened in the form of side tools, but are used in just the opposite manner, being fed in from the outside. The tools in the blocks are, of course, located laterally in fixed positions and size the distances across and between the cheeks of the crankshaft. For adjusting for depth of cut, the screws *E* are provided. Clamping bolts *F* hold the tools firmly in place. In order to face the cheeks of the three throws, it is necessary to have four tool-blocks, and the one at the extreme left, it will be noticed, requires but one tool for machining the outside of the first throw. The shaft is then reversed and the remainder of the throws are completed.

### Line-reaming the Engine Bearings

The line-reaming of the engine bearings for the locomobile is a very interesting operation and leaves the bearings in excellent condition. Briefly, the work consists of reaming three guide bearings, one at each end and one at the center, reaming the intervening bearings, and finally finishing by planish-broaching the entire set of seven bearings. By referring to Fig. 6, a good idea of the way the operation is performed may be obtained. The operator first inserts steel plugs at each end of the casing in the timer-shaft bearing holes and the cam-shaft bearing holes. Two of these studs may be seen at

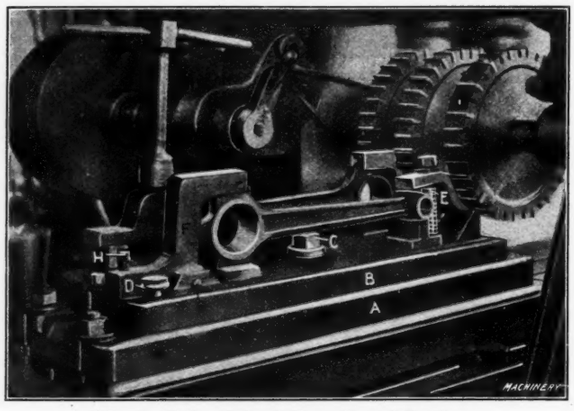


Fig. 4. Facing Ends of Connecting-rod Bearings

*A* and *B* in Fig. 6. Over these studs are slipped the end bearing caps *C* and *D* that support the reamers and broaches while doing their work. Reamer *E* is now put into position and the bearing caps at the ends and center are clamped in place. These three bearings are now reamed by means of the hand wrench at the end, following which the remainder of the bearing caps are put into place, first, however, putting the reamer *F* into position. By observing reamer *F* in its position in front of the fixture, it will be seen that there are four sets of blades for the purpose of reaming the four bearing caps and bearings, two of which are at each side of the center. Thus reamer *E* reams the central and two end bearings, and reamer *F* reams the two bearings on each side of the center bearing, completing the total of seven.

The finishing of the bearing surfaces by planish-broaching is performed in a similar manner to that in which the reaming is done. This operation is shown in Fig. 8. The end of the broach is in the form of a screw and is shown at *A*. This screw is for the purpose of pulling the broach through the work and it works within the long nut *B* which is held against the last bearing. In order to divide the pulling strain of the broaching operation, expansion bushings *C* are placed between each pair of bearings. These expansion bushings

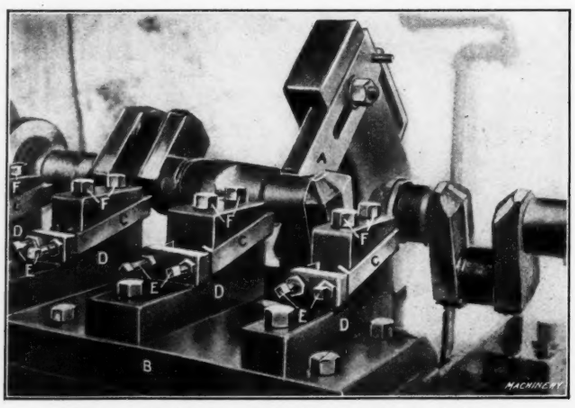


Fig. 5. A Tool Set-up on the Engine Lathe for facing the Cheeks of Crankshaft

may be opened out until all of the space between the bearings is taken up; thus the thrust is not all taken on the first bearing. Only a few thousandths inch of stock is planished by the broach, but it is enough to harden the surface of the bearing and give it a true as well as a long wearing surface.

Two types of a surface grinding machine that is used largely at the Locomobile Co.'s factory are shown in Figs. 7 and 9. These views show the upright and horizontal types of the "Peerless" surfacing machine. This machine is of the emery belt type, working against a surface plate. Miscellaneous castings of brass, aluminum, iron or steel are surfaced on these machines and they are then ready for assembling. One advantage claimed for the machine is that the finishing lines left on the work all have the same direction. Because the belt is traveling at the same rate of speed at the center and edges, there is no tendency for it to cut faster at any

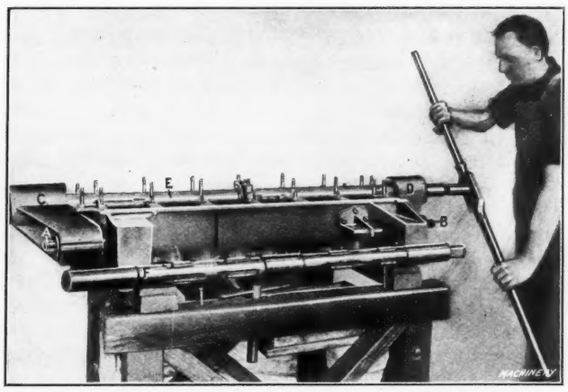

Fig. 6. First Operation in line-reaming the Engine Bearings

particular point, which is often the case on other types of grinding machines.

### Letting Light into the Stock-room

One of the surest ways of having things run as they should is to pull them out into the light where they will be in plain view of everyone. This is just the principle that is employed in running the stock department for finished parts at the Locomobile factory. Many stock departments are run in a haphazard way, and the number of finished parts on hand or needed is always a question. For instance, if ten parts of one kind are required each week, unless things are run very carefully there are likely to be weeks when there will be only five or six parts supplied and other weeks when it will run up to fifteen or twenty. In this factory, such trouble is helped by a series of large blackboards posted in front of the finished parts stock-room on each floor. One of these blackboards that well explains the system may be seen in Fig. 10.

Fig. 7. Vertical Type of "Peerless" Surfacing Machine

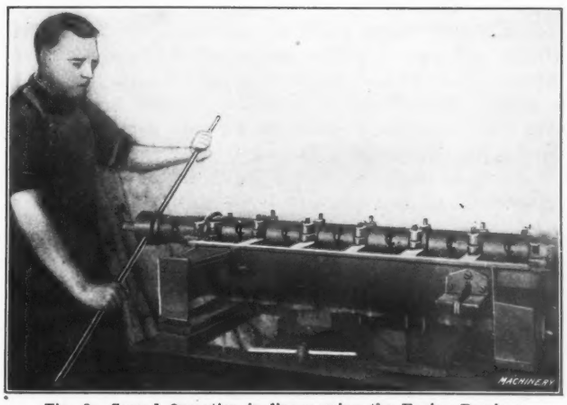

Fig. 8. Second Operation in line-reaming the Engine Bearings

Forty of these boards are now in use for keeping the production records of the most important parts. Each part or unit is assigned a part number and opposite it is the weekly schedule, that is, the number of parts required each week to keep up the standard production. This schedule may be changed from time to time in accordance with the production requirements. Following this column is a series of five spaces for registering the deliveries made each week. Each week also, the total number of parts delivered is changed to agree with the increase, and in the last column is the number of pieces that will be required on a certain date. Thus the superintendent, foreman or any of the workmen may see at a glance, without going through any red tape, just what the condition of the stock is, whether they are falling behind or getting

Fig. 9. Horizontal Type of "Peerless" Surfacing Machine

ahead on any one part, and will be able to direct their attention accordingly. Take, for instance, on the blackboard shown in Fig. 10, part No. 59,006. The weekly schedule on October 25 called for fifty-four pieces; on October 11 fifty pieces were delivered to the stock-keeper, four pieces below the standard required. On October 18, sixty-one pieces were delivered, bringing them a little ahead of the schedule. On October 25, fifty-seven pieces were delivered, putting them a little farther ahead. The total number of pieces delivered up to October 25 was seven hundred and ninety-eight, and on November 8 nine hundred pieces would be required. As there were two more delivery dates, November 1 and November 8, the schedule of fifty-four pieces a week would bring them to nine hundred and six pieces, which is slightly in excess of what is desired. One of the principal advantages of the system is that it is right in the limelight so that everyone knows what everyone else is doing—there is nothing that can be covered up.

Supplementing the blackboard system, are the production record blueprint sheets which are made out, one for each department and one as a summary of all departments, giving the general condition of the stock in the whole factory. These are shown, respectively, in Figs. 11 and 12. In Fig. 11 is shown the record that is made out for each department. This record is for Department 24 and is a summary of all the blackboards in that department. Each week a clerk posts on this chart the number of pieces listed on the blackboards. He

CRANK SHAFTS, CAM SHAFTS, CONNECTING RODS
This Schedule does not include Part Orders

| PART NUMBER | WEEKLY SCHEDULE 10/25 | WEEKLY DELIVERIES 10/1 | 10/8 | 10/25 | 11/1 | 11/8 | TOTAL DELIVERED TO 10/25 | TOTAL REQUIRED 11/8 |
|---|---|---|---|---|---|---|---|---|
| 61000 | 12 | 10 | 11 | 9 | | | 195 | 225 |
| 65003 | 18 | 17 | 19 | 20 | | | 266 | 300 |
| 57217 | 30 | 26 | 28 | 25 | | | 454 | 525 |
| 57218 | 28 | 30 | 28 | 31 | | | 474 | 525 |
| 61436 | 12 | 12 | 0 | 21 | | | 196 | 225 |
| 65013 | 18 | 20 | 16 | 30 | | | 276 | 300 |
| 56455 | 35 | 30 | 27 | 32 | | | 439 | 525 |
| 59030 | 18 | 17 | 11 | 22 | | | 260 | 300 |
| 61437 | 12 | 8 | 10 | 0 | | | 183 | 225 |
| 56388 | 28 | 31 | 34 | 30 | | | 480 | 525 |
| 57001 | 36 | 30 | 42 | 27 | | | 595 | 675 |
| 57002 | 36 | 12 | 30 | 28 | | | 565 | 675 |
| 59006 | 54 | 50 | 61 | 57 | | | 798 | 900 |
| 58007 | 54 | 12 | 96 | 42 | | | 780 | 900 |

Fig. 10. Blackboard showing Condition of Stock at All Times to Everyone

figures out the percentage of parts that are above and below the schedule called for, and enters them on the chart. Thus on November 1, 42 per cent of the parts made in Department 24 were above schedule, 14 per cent were below schedule and the balance or 44 per cent were on a normal basis. This is carried out from week to week and thus by observing the rise and fall of the record, an accurate check may be kept on the stock of the department. The nearer the two record lines approach the normal line, the more ideal is the production.

Similarly, a blueprint record is kept for the chief executive of the factory which gives a summary of the production of the different departments. On this latter record is kept the total number of parts from all departments, and from week to week the percentage above or below schedule is noted on the chart. This, of course, results in two lines across the chart that denote the progress in keeping up with the demands of stock. The record in Fig. 12 denotes, for instance, on September 20 that, in the entire factory, 34 per cent of the parts were above the desired schedule and 40 per cent were below schedule. The balance, 26 per cent, was normal. On

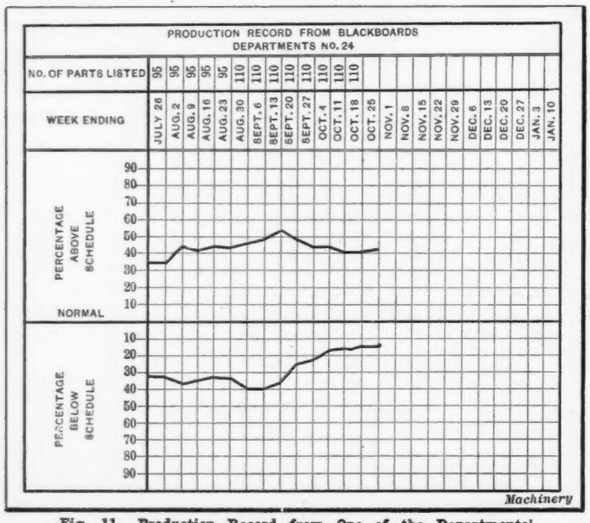


Fig. 11. Production Record from One of the Departments' Blackboard Bulletins

November 1, however, the condition of the general stock was much better, as only 23 per cent was above schedule and 17 per cent below schedule, leaving 60 per cent of the stock normal. This stock-keeping system has worked out very successfully and shows at a glance just how things stand in any one department or in the factory as a whole.

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## MOVING PICTURES IN SCIENTIFIC RESEARCH WORK

The part that moving pictures have played in scientific and technical research is outlined by Dr. Hans Goetz in the *Zeitschrift des Vereines deutscher Ingenieure*. One of the ways in which the moving picture acts as an aid to science is in recording rare phenomena, such as observed in the life of animals that are seldom seen, or those that are difficult of access, unusual surgical operations, etc. This is only the beginning of the usefulness of the moving picture in scientific research. The fact that by an increase in speed it is possible to produce, in a few minutes, a record of what has taken place during several days or even months, as, for instance, the possibility of producing in three minutes a ten-day period of growth of a plant, where pictures were taken at five minute intervals, is a very interesting and valuable aid to science. A large field for the study of the growth of plants is thus opened up. Just as the slow movements can be hastened so that it is possible to see the total effect in a better perspective, so it is also possible to retard and analyze quick movements. With the most refined mechanical device it is not possible to take more than 250 pictures per second, but by illuminating the moving object with regularly succeeding electric sparks and photographing on a film moving continuously, rather than intermittently, it has been found possible to increase the number of exposures to 2000 per second. The flight of insects, for instance, can be shown very clearly in

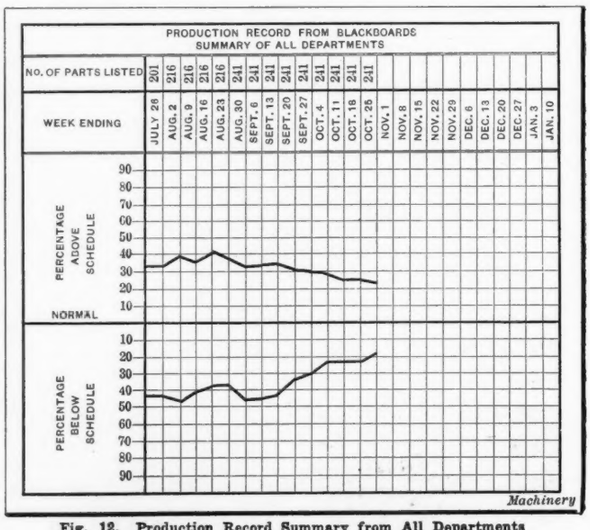


Fig. 12. Production Record Summary from All Departments showing Percentage of Parts above and below Schedule

this manner. In engineering, moving pictures have been used in studying the flight of projectiles and their effect on armor plate. Electrical apparatus, with high frequencies, are necessary for this purpose, and from 9000 to 50,000 exposures per second are obtained by this method. The moving picture thus opens up a field for studying on the one hand motions that are so slow that it has hitherto been impossible to form any conception of them as a whole, and on the other, of movements that are so rapid that it has been impossible in any way to study the details connected with them.

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The temperatures at which certain substances in contact with the atmosphere at ordinary pressures will catch fire are assumed to be as follows: Illuminating gas, 1110 degrees F.; benzine, 780 degrees F.; petroleum, 715 degrees F.; gas oil, 660 degrees F.; machine oil, 715 degrees F.; coal tars, 930 degrees F.; tar oil, 1075 degrees F.; and benzol, 970 degrees F.

# CENTERING DEVICES

TWELVE DIFFERENT MECHANISMS FOR RETURNING A MACHINE MEMBER TO THE STARTING POINT

BY CHARLES A. CLARK*

CENTERING devices, as their name implies, are used for automatically returning machine members to the starting point or central position. A typical application is on alternating current motors where a centering device is required owing to the necessity of subjecting the motor windings to a low voltage in starting the motor, after which the full voltage is used for running under normal conditions. In the event of the current's failing, it is necessary for the starting switch to be returned to the "off position," and for this purpose a centering device is used. When the switch is pulled over to the "running position" it is held in place by an electromagnet, but in the event of the current's failing the magnetic attraction ceases. The centering device is then able to return the switch to the off position.

Fig. 1 shows a mechanism which is known as a Gherkin's latch which is used in conjunction with certain types of centering devices. This latch consists of a handle *A* which is mounted on shaft *B*. The handle has a projecting boss *E* which engages with the latch *C* that is pivoted on the pin *D*.

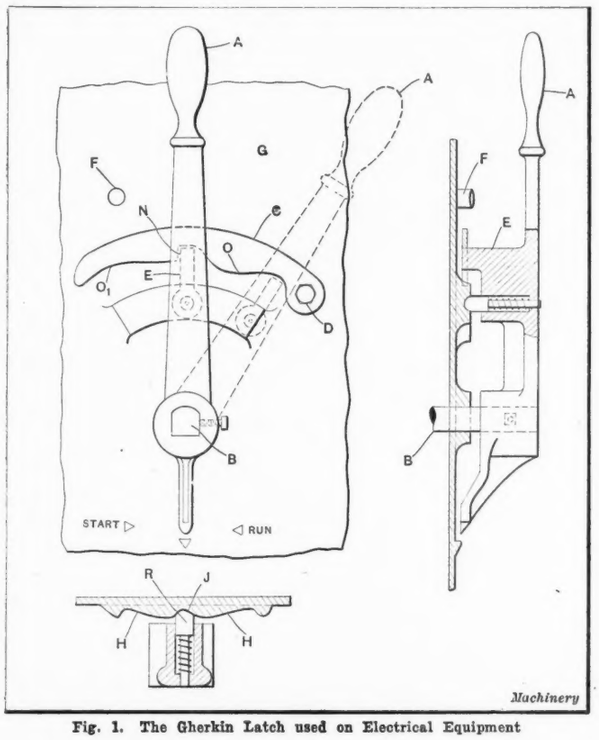
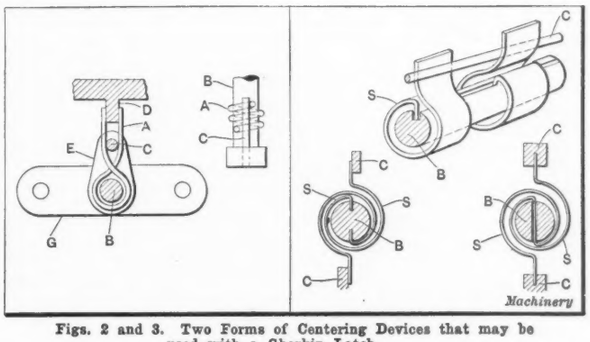



Fig. 1. The Gherkin Latch used on Electrical Equipment

The pin *D* is carried by the case *G* and the movement of the latch is limited by a second pin *F*. This latch is so constructed that when the handle is moved slowly to the left, the latch will prevent the handle moving beyond the notch *N;* but if the handle is moved over to the extreme right—as shown dotted in the illustration—and then thrown quickly in the opposite direction, the boss *E* on the handle will leave the top of the incline *O* on the latch with sufficient speed to enable it to jump across the notch *N*, in which case the handle will come to rest in the position marked $O_1$ which is the running position. The pin *R* riding on the surfaces *H* will lock the handle in the cavity *J* when the action of the centering spring becomes effective. In this way the handle is securely held in the central or off position. This latch may be used in connection with either of the centering devices shown in Figs. 2 and 3. The centering spring has one end attached to the shaft *B* of Fig. 1 and the opposite end to the case *G*.

Referring to the illustration of the centering spring, or so-called "cross legged spring" shown in Fig. 2, it will be seen

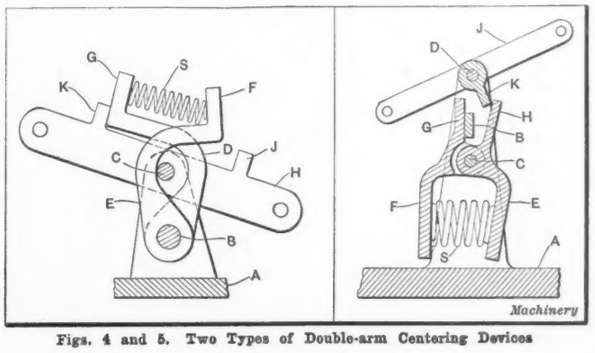
* Address: 2059 Eighth Ave., New York City.



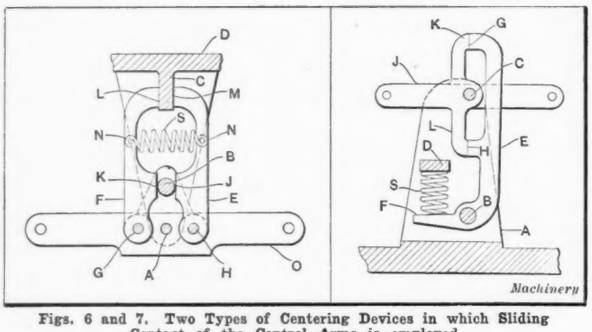

Figs. 2 and 3. Two Forms of Centering Devices that may be used with a Gherkin Latch

that a coiled spring *A* is employed to connect the shaft *B* with the case. The effectiveness of this spring is dependent on the following conditions: first, that the ends cross each other in a line which is perpendicular to the horizontal axis of the spring; second, that the ends of the spring extend far enough above the outside of the coils to enable a pin or bar *C* and a fixed boss *D* to be inserted between these two ends. This condition is clearly shown in Fig. 2. The pin or bar *C* is carried by the crank *E*, which, in turn, is carried by the shaft *B* of the mechanism shown in Fig. 1. An arm *G* or some other means provides for transmitting the motion so that when the shaft *B* is moved in either direction the cross legged spring will be put in tension by having one end turned through the action of the pin *C*. This spring tension provides for returning the arm *G* and the shaft to which it is secured to the central position when the action of the spring becomes effective. A very simple centering device is illustrated in Fig. 3, the only difference from the preceding type being that two separate springs are employed in this case. One end of each of these springs *S* is secured in a slot in shaft *B*, while the other end is held by the fixed pin *C*. When shaft *B* is turned in either direction, one of these springs is put under tension and this spring tension provides for returning the shaft to the central position when the action of the spring becomes effective. Two modifications of this design are shown in the lower corners of this illustration.

Another form of centering device is illustrated in Fig. 4. Referring to this illustration, it will be seen that there is a bracket *A* which supports a pivot *B* and a pin *C*. Two arms *D* and *E* are mounted on the pivot *B*, on which they are free to swing. On the ends of the arms are projections *F* and *G* which are secured to opposite ends of the spring *S*. These projections *F* and *G* also engage with bosses *J* and *K* on the moving member *H*. This moving member is carried by the pin *C*, upon which it is free to swing. Assuming that the moving member *H* is rotated in a clockwise direction, the centering device will assume the position shown in Fig. 4. The arm *E* is held against the pin *C*, while the boss *G* on the arm *D* engages the boss *K* on the movable member *H*. Further rotation of the member *H* will compress the spring



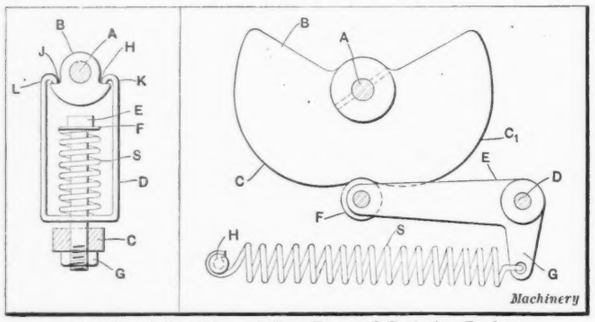

Figs. 4 and 5. Two Types of Double-arm Centering Devices




Figs. 6 and 7. Two Types of Centering Devices in which Sliding Contact of the Control Arms is employed

*S* and this will return the movable member to the central position when the action of the spring becomes effective. If the movable member *H* is rotated in a counter-clockwise direction, the action of the centering device will be exactly reversed, the arm *D* being held by the pin *C* while the boss *F* on the arm *E* engages the boss *J* on the movable member *H*, thus causing the compression of the spring *S*.

In the centering device shown in Fig. 5, the frame *A* is provided with a stop *B* and two pivots *C* and *D*. Two arms *E* and *F* are mounted on the pivot *C*, these arms being free to swing and provided with projections *G* and *H* at their upper ends. When the centering device is in its normal position, both of the projections *G* and *H* are in contact with the stop *B*, owing to the action of the compression spring *S* which forces the lower ends of the arms in opposite directions. It will be seen that the movable member *J* is mounted on a pivot *D* and provided with a projecting lug *K* on its lower side. This lug engages with the projections *G* and *H*, and when the member *J* is rotated in either direction, it swings one of the arms about the pivot *C* and compresses the spring *S*. When the action of this spring becomes effective, it returns the arm to the normal position; and the projection at the upper end of the arm acts on the lug *K*, causing the movable member *J* to be returned to the starting point.




Figs. 8 and 9. Yoke and Cam Types of Centering Devices

The centering device illustrated in Fig. 6 works on a somewhat different principle from that of the preceding types. Referring to this illustration, it will be seen that the frame *D* carries a stop *C* and a pivot *A*. The movable member *O* is carried by this pivot *A*, and, in turn, carries two arms *E* and *F*. The arm *E* is carried by the pivot *H* and provided with two sliding surfaces *J* and *M* which work in contact with the pin *B* and the boss *C*, respectively. The arm *F* is supported on the pivot *G* and has two sliding surfaces *K* and *L* which work in contact with the pin *B* and the boss *C*, respectively. The tension spring *S* is secured to the arms *E* and *F* at the points *N*. Assuming that the movable member *O* is to be rotated in a clockwise direction, the arm *E* will be pulled down by the supporting pivot *H* and in so doing, the surfaces *M* and *J* will slide on the boss *C* and pin *B*. For the same reason, arm *F* will be pushed up, the surface *L* sliding on the boss *C* and the surface *K* sliding on the pin *B*. This action increases the distance between the pins *N* to which the spring is secured, thus putting the spring *S* under tension; and when the action of this spring becomes effective, it will return the movable member *O* to the starting point.

In the device shown in Fig. 7, the frame *A* carries two pivots *B* and *C*, and a boss *D* to which one end of the spring *S* is secured. The arm *E* is pivoted at *B* and has a projection *F* which engages the opposite end of the spring *S*; this arm also has two sliding surfaces *G* and *H*, which work in contact with the projections *K* and *L* on the movable member *J*. This movable member is carried on pivot *C*. When the member *J* is rotated in either the clockwise or counter-clockwise direction, one of its projections causes the arm *E* to be rotated in a clockwise direction about the pivot *B*. When this rotation takes place, the projection *F* on the arm *E* compresses the spring *S*. When the movable member *J* is released, the action of the spring *S* becomes effective and returns it to the central position.

Fig. 8 shows a form of centering device which is limited in its application but has been found particularly effective in those cases where it can be used. It is only applicable for returning mechanisms which have a relatively small angular movement. Referring to the illustration, it will be seen that the shaft *A* has a hub *B* secured to it. An arm or other means of transmitting the motion may be secured to the shaft *A*. The hub *B* has two recessed surfaces *H* and *J* that receive the ends *K* and *L* of the yoke *D*, which is held in position by means of a bolt *E*. The opposite end of this bolt is carried by a lug *C*, and the bolt carries a spring *S* and washer *F* which supports the pressure of the upper end of the spring. When the shaft *A* is rotated in either direction, the hub *B* raises the yoke *D*, thus compressing the spring *S*, and when

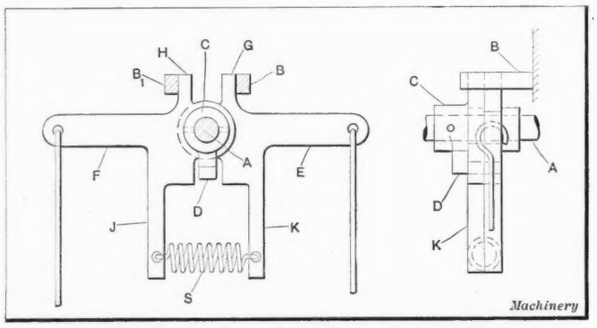
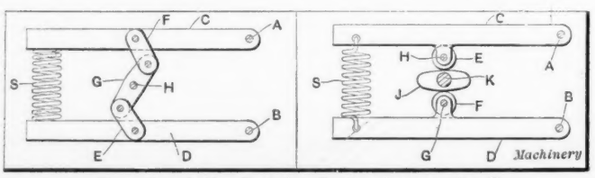



Fig. 10. Another Form of Double-arm Centering Device

the action of this spring becomes effective, it pushes down the yoke and returns the shaft *A* to the starting point.

One of the simplest forms of centering devices that can be used consists of the combination of a cam, bellcrank and spring illustrated in Fig. 9. Referring to this illustration it will be seen that the shaft *A* has the two-lobed cam *B* secured to it. The bellcrank *E* is mounted on the pivot *D*; and this bellcrank has the cam roller *F* mounted at one end and the other end secured to the spring *S*. The opposite end of the spring is secured at the point *H*. When the shaft *A* is rotated in either direction, the lobe *C* or $C_1$ of the cam pushes down the end of the bellcrank; and this causes the crank to rotate about the pivot *D*. The result is that the opposite end *G* of the bellcrank swings out and places the spring *S* under tension. When the action of this spring becomes effective, it rotates the bellcrank in the opposite direction and returns the shaft *A* to the starting point through the action of the cam roller *F* on the cam.

A type of centering device which finds wide application in the control of oil switches is illustrated in Fig. 10. In this illustration, *A* represents a shaft to which a hub *C* is secured. This hub carries a projecting lug *D* which extends between the two arms *E* and *F* of the centering device. These arms are free to swing about the shaft *A*. The arm *E* is provided with an extension *K* to which one end of the spring *S* is




Figs. 11 and 12. Centering Devices for returning Two Arms simultaneously

secured, and a second extension $G$ which limits the movement of the arm $E$ in a clockwise direction through contact with the stop $B$. The arm $F$ has an extension $J$, to which the opposite end of the spring $S$ is secured, and a second extension $H$ which limits the rotation of the arm $F$ in a counter-clockwise direction through contact with the stop $B_1$. The tension of the spring $S$ holds the arms $E$ and $F$ against their respective stops $B$ and $B_1$. When shaft $A$ is rotated, the hub $C$ and its lug $D$ are moved in either a clockwise or counter-clockwise direction as the case may be. This rotation causes either the arm $E$ or $F$ to be rotated against the tension of the spring $S$, and when this spring tension becomes effective it causes the shaft $A$ to be returned to the starting point.

Figs. 11 and 12 show two simple devices for returning two levers to their normal positions. In the device shown in Fig. 11, the lever $C$ is carried by the pivot $A$ and the lever $D$ is carried by the pivot $B$. An arm $G$ is pivoted between these levers and connected to them by means of two links $E$ and $F$. When arm $G$ is rotated in a clockwise direction, it causes levers $C$ and $D$ to swing in about pivots $A$ and $B$, thus placing the spring $S$ under compression. When the force tending to bring the levers $C$ and $D$ together is released, the compression of the spring $S$ will return the levers to their normal positions. The arrangement of the mechanism shown in Fig. 12 is quite similar to that of the preceding illustration, except that the levers $C$ and $D$ are provided with cam rolls $E$ and $F$ which are mounted on pivots $H$ and $G$. When the cam $J$ is rotated in either direction, by turning the shaft $K$, it causes the levers $C$ and $D$ to swing outward about the pivots $A$ and $B$, thus placing the spring $S$ under tension. When the torque tending to rotate the shaft $K$ is released, the tension of the spring $S$ returns the levers $C$ and $D$ to the starting point.

* * *

## THE SAND-BLAST FROM THE USER'S VIEWPOINT*

The foundry sand-blast was developed for the cleaning of castings, and its many advantages for cleaning or surfacing in all branches of metal working, plating and finishing have been so fully demonstrated that it is today a fixture. Thoroughly sand-blasted castings can be machined more rapidly and at reduced expense. The value of the sand-blast in sheet and structural steel work has been thoroughly demonstrated, and the railroads generally demand the sand-blasting of steel cars before painting. A smooth surface results and the paint protects the metal better from corrosion. Metals to be plated, japanned, galvanized, sherardized, or treated with the various rust prevention processes, such as "Coslettizing," "Bower-Barff," "carbonium," etc., are thoroughly cleaned by the sand-blast preparatory to treatment. Bars, rods and plates to be electrically welded are freed from scale and rust in order to insure perfect contact.

A variety of sand-blast apparatus is available for foundrymen and other users; for small work adapted in size and shape for cleaning in the sand-blast barrel there can be no question of the economy of this type of machine. Pieces too large for successful barreling may be cleaned with the least labor on the round and reciprocating type table machines, but if the pieces are of such shape or design as to demand constant turning to bring all surfaces under the action of the nozzle, one of the small enclosed cabinets of the self-contained continuous feed type, with stationary or portable nozzle, may be found more efficient. The combination pressure blast and cabinet machine also affords at small cost efficient equipment for a small volume of work of varied character. It is safe to say, however, that the varied character and limited output of the majority of foundries and other plants requiring self-blasting equipment is best served by machines that will clean everything and anything. For these the hose type machine is most efficient. It is simple, having few working parts, and the up-keep cost is reduced to a minimum.

Under pressure of 80 pounds per square inch a 3/16 inch nozzle will discharge 48 cubic feet of free air per minute and 500 pounds of sand per hour; a ¼ inch nozzle discharges 85 cubic feet of air per minute and approximately 900 pounds of sand per hour; a 5/16 inch nozzle, 133 cubic feet of air per minute and 1300 pounds of sand per hour; a ⅜ inch nozzle, 191 cubic feet of air per minute and 1700 pounds of sand per hour; a ½ inch nozzle, 340 cubic feet of air per minute and approximately 3000 pounds of sand per hour.

What is the most satisfactory working pressure is a question much discussed, but to which there is but one answer, and that is the pressure at which the work can be done the cheapest, all other factors being considered. If it is required to remove loose sand from castings a working pressure of 30 pounds or less will undoubtedly be satisfactory even on iron or steel, and should provide a surface suitable for painting. If, however, the castings are to be machined, every particle of the fused sand should be taken off in order to expose the clean metal to the action of the cutting tool. This condition on steel can be secured only with sand-blast pressure up to 90 pounds in order to be economical. Removing all the fused sand will not only reduce tool expense materially, but in actual practice has demonstrated that the output of machine tools will be increased at least 15 per cent.

In order to determine the most economical pressure for sand-blasting apparatus there must be taken into consideration, besides the elements of labor and abrasive, the initial pressure at which the air is being delivered from the compressor. The majority of pneumatic equipment in use today requires about 80 pounds pressure, and in some installations of sand-blast apparatus we find the air supply is being delivered to the receiver at this pressure. While it might be demonstrated that the castings could be most economically cleaned at a lower pressure if the air were initially compressed to that pressure, it is manifestly cheaper to use the air at the full or standard pressure of 80 pounds if other requirements in the plant demand that pressure. The fact must not be lost sight of that every cubic foot of air used for sand-blast purposes which is reduced to the lower pressure costs the same in horsepower expenditure that it would if it were used at the initial pressure of 80 pounds.

Tests made by Prof. William T. Magruder, reported in a paper read before the American Society of Mechanical Engineers, to determine the amount of metal removed by a sand-blast showed that the time required to remove one pound of iron with 20 pounds pressure was 3.55 hours; 30 pounds, 2.77 hours; 40 pounds, 2.13 hours; 50 pounds, 1.52 hour; 60 pounds, 1.07 hour; and 70 pounds, 0.82 hour. In one instance it was shown that 230 cubic feet of free air requiring 73 horsepower to compress, was discharged through a 9/16 inch nozzle at 40 pounds pressure, and 120 pieces weighing 200 pounds each were cleaned in a ten-hour day. With a pressure of 80 pounds passing through a ½ inch nozzle, flowing 140 cubic feet of free air per minute, 156 pieces were cleaned in ten hours. In the first instance the air was compressed to 80 pounds and passed through a reducing valve to the sand-blast machine. Had the air in the first instance been initially compressed to 40 pounds the power saving would have been over 12 per cent of the higher pressure to say nothing of the greater output. The general proposition of the low pressure cleaning is volume of sand, which requires the large hose and nozzle, consuming air at low pressure and cost, while the high pressure provides a minimum of sand driven with high velocity through a small hose and nozzle with high pressure and cost of air. The horsepower cost is approximately the same for the same results by either operation with the air initially compressed to the operating pressure, and the determining factors will therefore be the volume of output with a minimum of labor cost.

* Abstract of paper read at a meeting of the Associated Foundry Foremen of New York and vicinity, by H. D. Gates, sales manager, sand-blast department of the De La Vergne Machine Co., New York City.

* * *

## USE OF WIRELESS FOR DISPERSING FOGS

Experiments are being carried out by one of the leading French railways with the use of wireless waves for dispersing mists and fogs. It is known that electric waves act upon the water particles which comprise fog in such a manner as to burn them into vapor. By this means it is claimed that as much as 600 feet can be cleared in front of the wires emitting the waves. This will obviously be of great value for railways and vessels at sea.

# SOME AUTOMOBILE SHOP TOOLS

SPECIAL TOOLS USED BY THE HUPP MOTOR CAR CO., DETROIT, MICH. FOR LAPPING CYLINDERS, LINE-REAMING CRANK-CASES, ETC.

In specialized manufacture, such as automobile engine building, it is necessary if an interchangeable product is to be secured, that the machining operations, especially the final ones, be carefully accomplished. It is also necessary that the machines be designed with the aim in view of obtaining uniformity of product and that all defects in previous operations be rectified. The Hupp Motor Car Co., of Detroit, Mich., takes particular pains with the final operations on its automobile engines, and a few of the most interesting machines used in this shop are illustrated and described in the following.

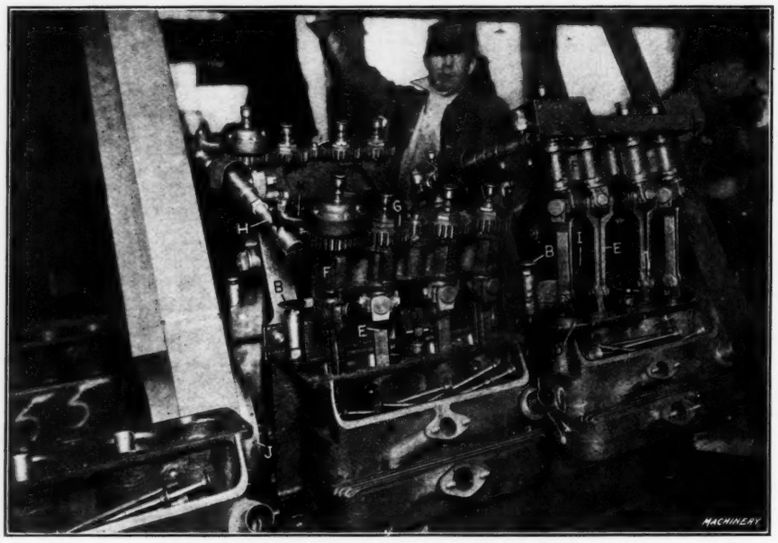



Fig. 1. Special Piston, Piston Ring and Engine Cylinder Lapping Machines of the Oscillating Type

### Cylinder, Piston and Piston Ring Lapping Machine

An interesting machine used for lapping cylinders, pistons and piston rings is shown in Fig. 1. The cylinders for Hupp four-cylinder engines are cast *en bloc*, and after the bore has been machined to the proper dimensions, the castings are brought to the machines shown in Fig. 1. These machines lap the cylinder bores, pistons and piston rings simultaneously and make a perfect running fit. The machine used for this purpose has a double head, and laps two castings—eight cylinder bores—at the same time, one casting being placed on each side of the machine as indicated in the illustration.

In operation, the cylinder castings *A* are placed in the proper position on the table of the machine, being located by two plugs *B* fitting into previously drilled holes in the base of the cylinder castings, and held in position by clamping screws *C*. The pistons *D* are then connected by the regular piston pins to special connecting-rods *E*. These, in turn, are fastened by a universal joint to the oscillating driving shafts held in the head *F* of the machine, which are oscillated by the train of gears *G* and shaft *H*.

This yoke or head *F* which comprises one casting is operated by a connecting-rod *I* fastened to the lower extension of the yoke and receiving motion from a crankshaft similar to that used in an automobile engine. This single-throw crankshaft is driven by pulley *J*.

At the same time that the yoke is being oscillated, the pistons are also oscillated. This is accomplished by means of the ball-jointed arms *H* which are given a slight twisting motion owing to the oscillation of the yoke, and consequently give a slight back and forth movement to the arm *K*; this arm is connected to the first gear *G* in the row and through intermediate gears, drives all the other gears in the line which, of course, are connected to the universal joint that carries the special connecting-rods. The pistons are moved up and down at the rate of 150 strokes per minute, and it requires twenty minutes to lap eight cylinders, pistons and piston rings. In order to make 150 strokes, it is necessary that the yoke itself turn over 300 times, giving 150 strokes for each casting, there being two *en bloc* cylinder castings lapped at the same time.

The lapping mixture consists of a fine grade of ground glass mixed with kerosene, which is applied to the pistons by means of a brush In the machine shown to the right the pistons are raised, to show how the special connecting-rods are fastened to them, and the illustration also shows how the casting is located and held down on the bed of the machine. One man russ the two machines and turns out an average of twelve cylinder castings per hour, finish-lapped and ready for assembling. Before assembling, however, the ground glass lapping mixture is removed by immersing the casting in benzine.

### Pneumatic Press for Inserting Valve Tappet Bushings

An efficient method of inserting valve tappet bushings in crank-cases for Hupp four-cylinder engines is shown in Fig. 3. This device is operated on the toggle principle, and is capable of exerting a pressure of 3000 pounds per square inch. It required 2800 pounds to insert the valve tappet bushing. Compressed air is supplied through the flexible tube *A* to cylinder *C* through valve *B*. The cylinder carries an extended boss which holds a foot member that locates directly under the point where the valve tappet bushing is to be inserted and above this is another extension that acts as a locating bracket for the device. The tappet bushing *D* when being inserted is located on a plug at the lower end of the toggle arm *E*, which is guided by the yoke *F* sliding on the post *G*. The pressure is then directed onto the bushing and the strain is taken on the lower extension of the cylinder, removing all strain from the crank-case when inserting the bushing. This method of inserting valve tappet bushings is superior to a screw or arbor press, because of the fact that no strains whatever are set up in the crank-

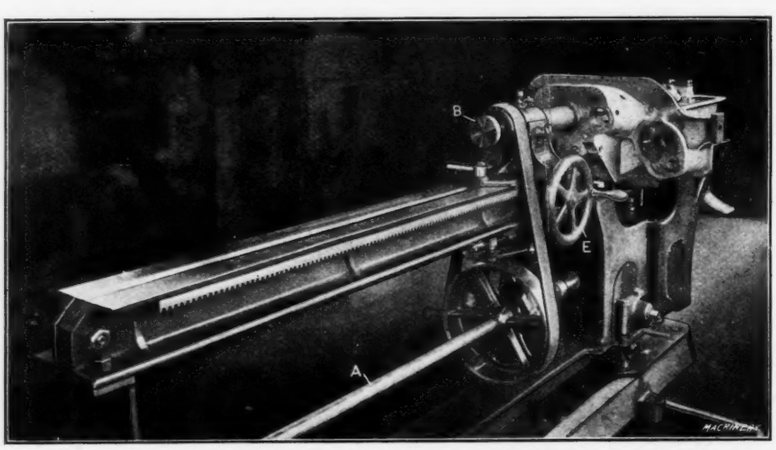



Fig. 2. Line-reaming Machine for finishing the Crankshaft Bearings in Crank-cases

case and the bushings are also set much more quickly. The device is suspended from an arm fastened to a post through a rope so that it can easily be swung around from place to place, or from bushing to bushing. It has greatly facilitated the insertion of valve tappet bushings in this plant.

### Line-reaming Crank-cases—Crankshaft Bearings

A unique type of special machine for line-reaming the crankshaft bearings in aluminum crank-cases is shown in Figs. 2 and 4, the latter illustration showing a closer view of the reaming end of the machine. This machine is driven by a 1½-horsepower motor, the power being transmitted to the lower shaft *A* through a worm and worm-wheel, thence to the spindle of boring-bar *B* by a belt as illustrated. The spindle which carries the boring-bar is operated at a speed of 300 revolutions per minute. The boring-bar carries single-point cutting tools.

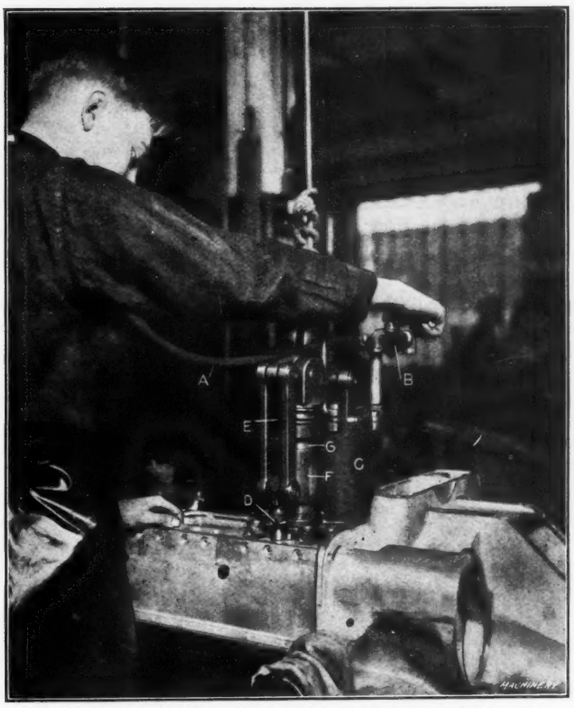



Fig. 3. Pneumatic Press for inserting Valve Tappet Bushings in Crank-cases without distorting the Crank-case

The pulley *C* slides on the lower shaft and the head *D* is driven along the base of the machine by a lead-screw, which, in turn, is driven from the worm previously referred to by a vertical shaft and a pair of bevel gears. The handwheel *E* is used for operating this boring head by hand when setting up the machine.

As a rule, crankshaft bearings are finished by line-reaming, but instead of single-point cutting tools, reamers are used. It is generally conceded by those who have had experience in this class of work that a reamer does not in any case give as truly a cylindrical hole as does a single-point cutting tool. In fact, the single-point tool when properly held and operated, can be depended upon to give an almost perfectly cylindrical hole. It was for this reason that the Hupp Motor Car Co., in an endeavor to get truly cylindrically bored bearings, designed this special machine in which the boring-bar *F* carries three single-point cutting tools *G*. There are three bearings that have to be machined. The supports or arms *H* carry hardened and ground bushings in which the boring-bar *F* rotates. This boring-bar, as previously mentioned, is rotated at a peripheral speed of 300 revolutions per minute and traversed at a feed of about 1/64 inch per revolution.

D. T. H.

* * *

## EXTINGUISHING FIRES WITH SAWDUST*

At first thought it might appear absurd to attempt to extinguish a fire by sprinkling sawdust upon it. "Adding fuel to the flames" is a time-honored figure of speech. As a matter of fact, however, sawdust is quite efficacious under certain conditions, if properly applied; and it is particularly well adapted for extinguishing small fires in oils and other inflammable liquids.

It is well known that combustion cannot continue in the absence of oxygen, and nearly every one has at some time or other smothered a small fire by covering it with a heavy cloth or some similar object, and thus excluding the air. Anyone who has seen a fire in a pile of sawdust has doubtless observed that after the outer surface of the pile has burned over, the remainder merely smolders, and seldom shows a flame. This is due to the fact that the sawdust particles pack together too closely to allow air to penetrate the surface of the pile freely enough to support the combustion actively. It is this characteristic feature of sawdust that gives it value as an extinguishing agent. It smothers the flames in the same manner as a blanket, by excluding the air.

Sawdust may be successfully used for extinguishing burning gasoline that has been spilled upon floors or on the ground; but it is of comparatively little value in the treatment of gasoline fires in large tanks, because it is almost impossible to spread the sawdust over the entire surface before some of it sinks to the bottom, exposing the surface at these points and allowing the liquid to re-ignite. It is far more useful in connection with liquids such as heavy oils, lacquer, japan, and melted wax, because it floats upon the surface of fluids of this type, and blankets them quite effectually.

The value of sawdust as an extinguishing agent can be considerably increased by the addition of a certain proportion of bicarbonate of soda (familiarly known as "baking soda"). This substance when exposed to heat gives off carbon dioxide gas, which materially assists in preventing the access of air. A mixture composed of ten pounds of bicarbonate to one bushel of sawdust has been found to be satisfactory, and tests have shown that by the use of this mixture fires may be extinguished more quickly and with a smaller amount of material than when sawdust is used alone.

The character of sawdust appears to have little effect upon its fire-extinguishing properties. Wet and dry sawdusts, from both hard wood and soft wood, have been tried with equally effective results. The sawdust should not be too fine, and it should be applied as quickly as possible, so as to cover the entire surface of the liquid. The application may be most effectively made by the use of a broad, flat shovel similar to a snowshovel.

As a precaution against fire in sawmills and other plants where dry sawdust collects in considerable quantities, it may sometimes be advisable to sprinkle sodium bicarbonate upon the sawdust piles at intervals. If a pile so treated were to become ignited, the bicarbonate would be of material assistance in checking the combustion.

Other substances may be even more effective than sawdust for smothering flames, but few things could excel it in the features of cheapness or ease of application.

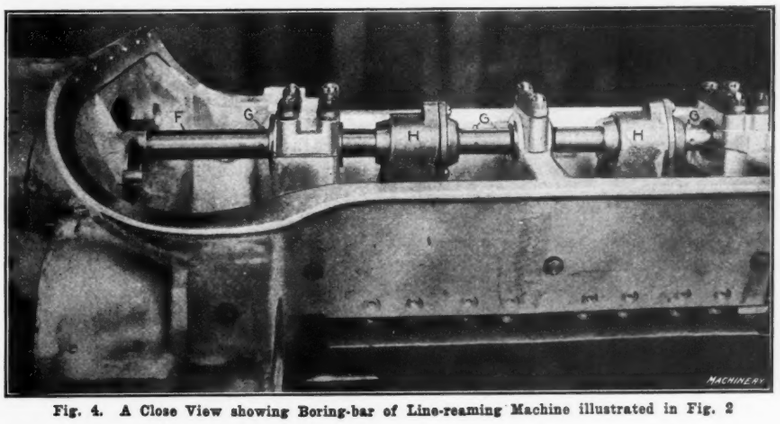



Fig. 4. A Close View showing Boring-bar of Line-reaming Machine illustrated in Fig. 2

* From the "Travelers' Standard," August, 1914.

# PROFILING OPERATIONS AT FACTORY OF SAVAGE ARMS CO.*

## INGENIOUS FIXTURES AND FORMERS USED FOR PROFILING RIFLE AND PISTOL PARTS

BY FRANKLIN D. JONES†

OWING to the irregular shapes of many rifle and pistol parts, a great many profiling operations are necessary in connection with their manufacture. In the plant of the Savage Arms Co., Utica, N. Y., the profiling practice has been developed to a high degree of efficiency and many ingenious fixtures and formers are used. This article is descriptive of some of the more important and unique operations.

### Profiling Inside of Finger Lever

The method of profiling the inside opening of the finger lever (such as is used on the '99 model action) is illustrated in Fig. 1. A concave cutter is used to form a convex surface on the work. The lever is held in the fixture by clamps *A* which are forced downward by the eccentric clamps *B*, and it is located by the two rods *C* and pin *D*. The latter enters the pivot hole of the lever and rods *C* extend beneath the left clamp *A* and bear against the left side of the lever. The opposite side, which has been rough-milled by a previous operation, is held firmly into contact with the fixture by rods *C* which are forced inward by an eccentric lever *E* that bears against a yoke connecting the two rods.

The former *F*, which is engaged by guide-pin *G* and controls the movement of the cutter, has a plain rectangular opening which, of course, conforms to the shape of the hole to be milled in the finger lever. When the profiling operation is completed, clamps *A* are withdrawn by means of handles *H* so that the lever can be lifted off the locating pin *D*. As will be seen, the former can be adjusted laterally if for any reason this should be necessary.

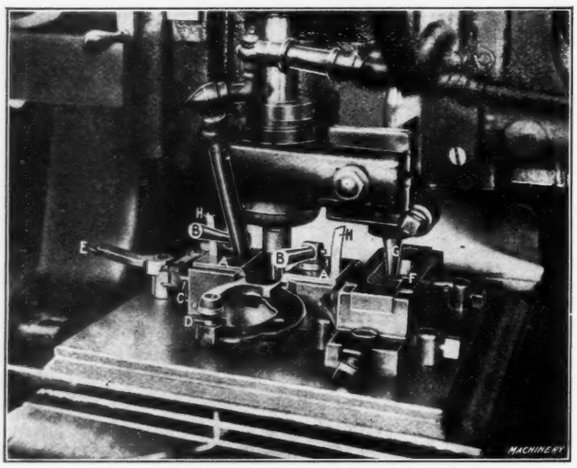



Fig. 1. Profiling Inside of Finger Lever for Rifle

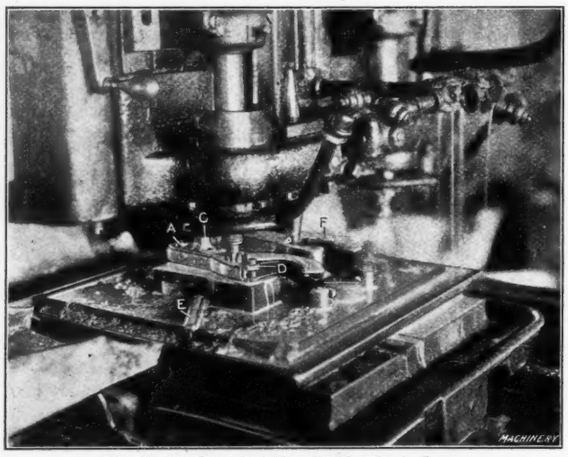



Fig. 2. Profiling Outside of Rifle Finger Lever

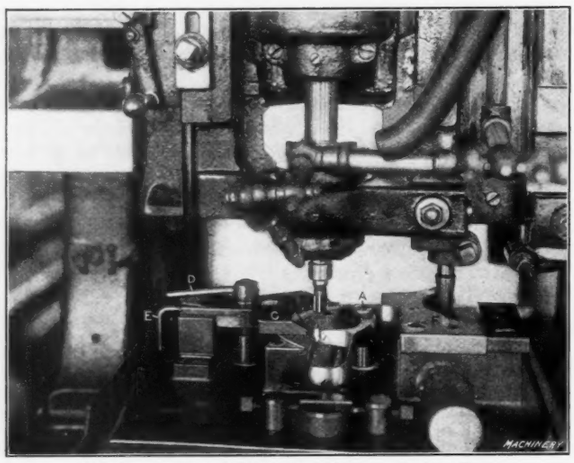



Fig. 3. Another Profiling Operation on a Finger Lever

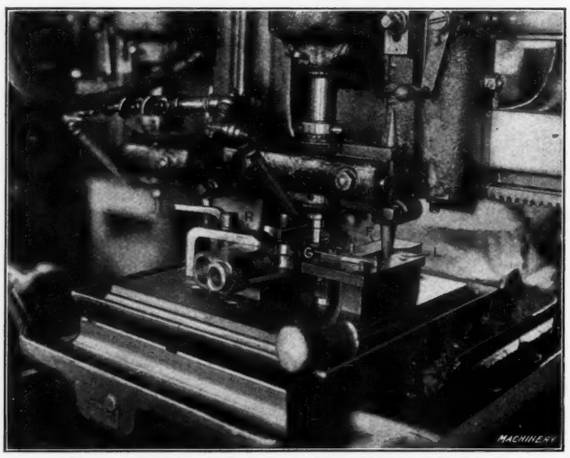



Fig. 4. Profiling Bolt Race in Lower Tang of Receiver

### Profiling Outside of Finger Lever

After the inside of the finger lever is milled, as described in the preceding paragraph, the outside surfaces are finished as indicated by Fig. 2 and the diagram Fig. 5. As the finger hole end of the finished lever is quite narrow, it is necessary to have the lever accurately located laterally so that one side will not be thicker than the other. The lever is located in the fixture by the inside of the finger hole and the pivot pin hole. Block *A* accurately fits the finger hole and is located by pins *B* inserted in the base of the fixture. This block has a projecting flange at the top, which is forced down onto the lever by bolt *C*, thus clamping the lever firmly in place. The location and length of the profiling cut are indicated by the arrows *a* and *b* in Fig. 5, and the surfaces of the former *F* which are used are shown by the arrows $a_1$ and $b_1$. After a lever is profiled, it is removed from the fixture by loosening clamp lever *E* and turning bolt *C* until its flat sides are aligned with the slot in block *A*; the latter is then lifted off the locating pins. As the end *D* is cylindrical and has small shoulders, it is milled by a formed cutter in a Lincoln type milling machine.

Still another profiling operation on the finger lever is shown in Fig. 3 and by the diagram Fig. 6. One continuous cut is taken as indicated by arrow *a* to form the edges of that end of the lever which enters the receiver and connects with

* For information on the manufacture of the Savage rifle previously published in MACHINERY, see "Manufacture of Savage 0.22 Caliber High-Power Rifle" in the July and August, 1914, numbers.

† Associate Editor of MACHINERY.

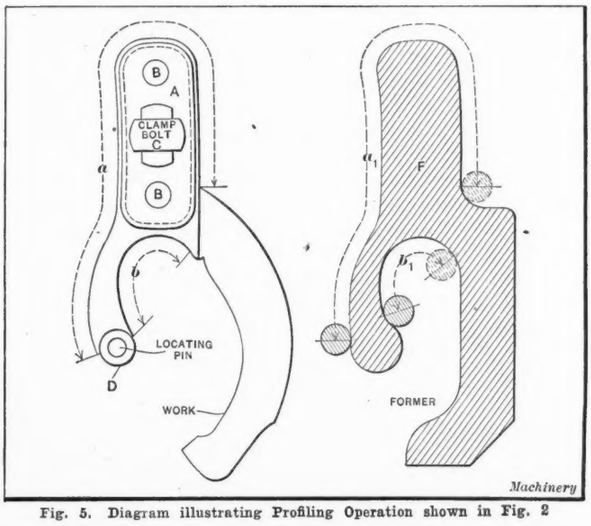



Fig. 5. Diagram illustrating Profiling Operation shown in Fig. 2

the breech-bolt. The surfaces at the extreme end must be accurately machined, as this end enters between the breech-bolt and a lug on the receiver (when the action is closed) to form a solid support for the bolt.

The lever is located by pin *A* which enters the pivot pin hole, and also by a small boss or pin at *B* (see Fig. 6) which is solid with the lever and enters a hole in the base of the fixture. (This pin engages a cam slot in the breech-bolt when the rifle is assembled.) The lever is held by a clamp *C* which is forced downward by a screw and lever *D*. The circular edge of the lever which is beneath this clamp is machined in a separate operation by a formed cutter, a Lincoln type machine being used. The former *F* is a plain type, shaped to correspond with the surface to be milled, and

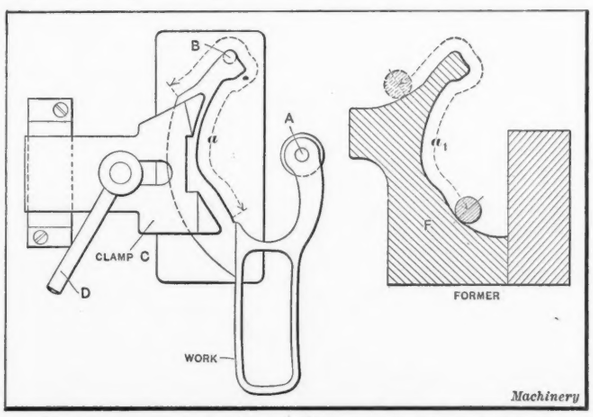



Fig. 6. Diagram illustrating Profiling Operation shown in Fig. 3

the path of the guide-pin is shown by the arrow $a_1$. To remove the finished work, clamp *C* is withdrawn by handle *E*, after being loosened, so that the lever can be lifted off the locating pin.

### Profiling Operations on a Rifle Receiver

The profiling operation illustrated by the halftone Fig. 4 and the diagram Fig. 7 is on the receiver of a rifle of the '99 model. Two separate cuts are taken by different cutters held in the two spindles. One cut *a* forms a guide way for the breech-bolt when the action is being opened or closed, and the other cut *b* extends from the lever support back to the trigger slot. When taking the longer cut *a*, a cutter is used that will mill a slot of the required width and the path of the guide-pin along the former *F* is shown by the arrow $a_1$. The projecting part *C* of the former is simply a guard to prevent the cutter from striking end *D* of the receiver when it is being removed at the completion of the cut. Plate *L* also forms a guard and prevents the cutter from striking the tang *J*. Before taking the shorter cut *b*, the plate *G* is swung across the former slot (as indicated by the dotted lines) and acts as a stop for the guide-pin so that the cut will be started at the correct point. This plate swivels on screw *H* and rests against a pin *K*. A small screw in the end of plate *G* provides an accurate adjustment. The curve at the beginning of cut *b* is equal to the radius of the cutter used.

The receiver is located for this operation by a pin in the base of the fixture at *S* which enters the sear pin hole, and also by a pin at *M* which enters the lever pivot hole. The work is further supported and located by a plunger *N* which is pushed into the trigger slot by lever *O*. The plunger is clamped in position by the lever *Q* and the receiver is held down against the base of the fixture by clamp *R*.

Fig. 8 shows how the cartridge guide slot is milled in the receiver. This is a narrow, straight slot about 3/32 inch wide and 2¼ inches long, on the right side of the receiver, which holds the cartridge guide. (This cartridge guide, in conjunction with the magazine carrier and ejector, holds the cartridge in the proper position.) The receiver is located by

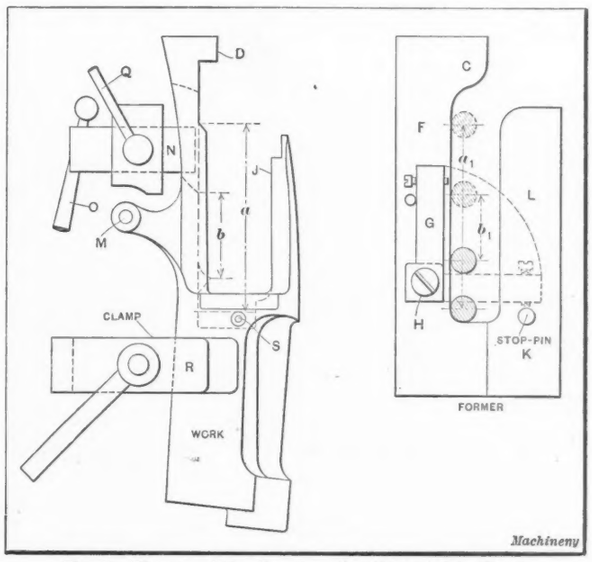



Fig. 7. Diagram of Profiling Operation illustrated in Fig. 4

the left side and the upper surface. The clamp screw operated by handle *A* forces the receiver against the vertical wall of the fixture and it is held upward against locating lug *B* by a bar *C* on the under side, which is raised by cam-lever *D*. As the slot is straight, the former *F* simply has a straight, rectangular opening. The cutter is located in the correct vertical position by bar *G* which engages a notch in slide *J* and is operated by lever *H*.

The gage for testing the accuracy of this operation is shown in Fig. 9 with a receiver in place. The receiver is located in the gage by the same surfaces against which it was held in the fixture, that is, by the left side and top. After the receiver is placed in the gage, bar *A* is swung around and the slotted end engages the locking post *B*. The receiver is held

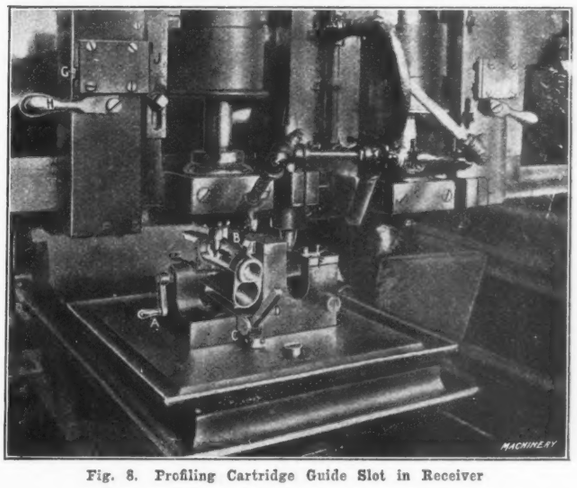



Fig. 8. Profiling Cartridge Guide Slot in Receiver

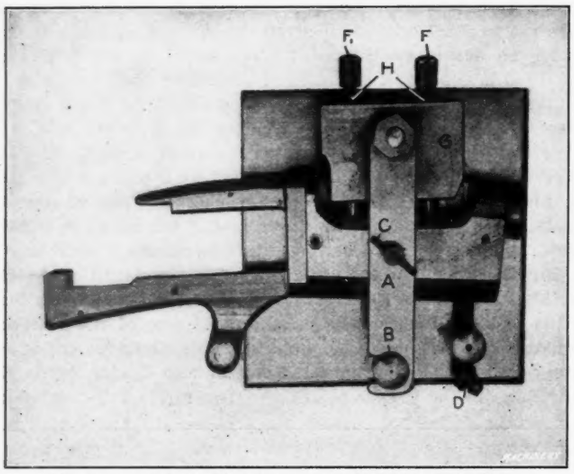



Fig. 9. Gage for testing Accuracy of Cartridge Guide Slots

downward and laterally by the screws *C* and *D*. The width of the slot and its location is tested by the combination finger and flush gages *F* and $F_1$. These gages have a cylindrical fitting in block *G* and the inner ends are provided with fingers which project at right angles and serve to gage the width of the slot when they are turned around in it. If the shoulders at *H* are flush with the gage body, they show that the slot is at the proper depth at both ends.

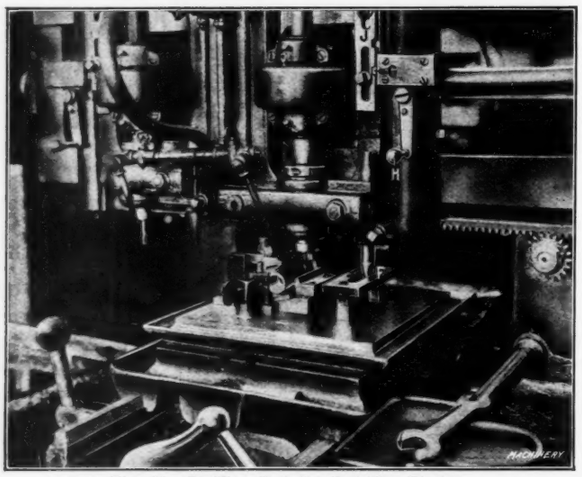


Fig. 10. Profiling Seat for Cartridge Ejector

The method of milling the mortise or slot which forms a seat for the ejector is illustrated in Fig. 10. This slot is slightly tapering and is at an angle with the side of the receiver; hence, the latter is held at an angle in the fixture as the illustration shows. The former *F* has a plain, tapering slot which gives the required shape. Before this seat is profiled, clearance holes are drilled at each end of the slot for the profiling cutter. Roughing and finishing cutters are used. The illustration shows the finishing cutter in position,

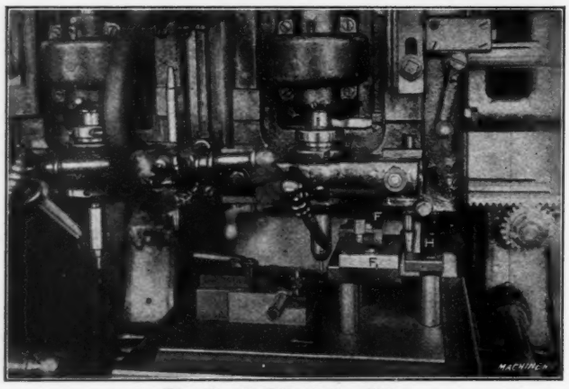


Fig. 11. Profiling Action Slide

the spindle and slide carrying the roughing cutter having been moved to the left. The depth of the cut is regulated by plunger *G* which engages the depth notch in slide *J* attached to the spindle slide. When plunger *G* is withdrawn by handle *H*, the slide is forced upward by a spring, far enough to clear the fixture so that it can quickly be moved away from the working position when the cut is completed.

### Profiling with Combination Former

A very interesting and unusual profiling operation is shown in Figs. 11 and 12. The work is the action slide for an automatic rifle of the 1914 model. The operation consists in taking first a shallow cut as indicated by the shaded area at *A*,

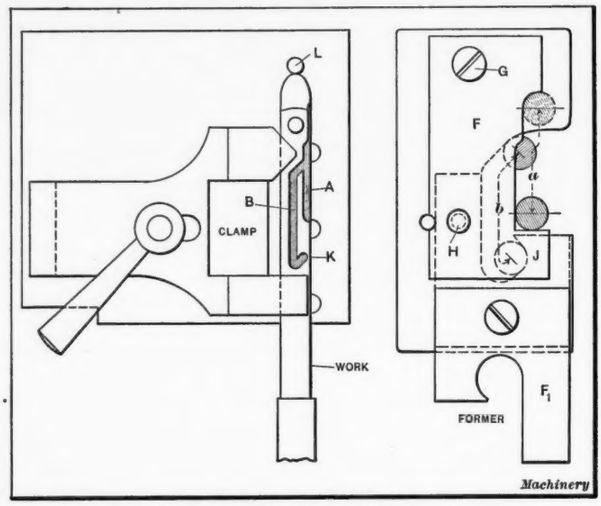



Fig. 12. Diagram showing Nature of Profiling Operation illustrated in Fig. 11

Fig. 12, and then a second cut as indicated at *B*. These surfaces must be accurately machined both as to location and depth. A combination type of former is used, and when taking the first cut *A*, plate *F* on the former is in the working position. This plate swivels about screw *G* and is located by a pin *H* which is inserted through the plate and into the former base. The path of the guide-pin is indicated by the arrow *a*. When the first cut is completed, plate *F* is swung back out of the way, and plate $F_1$ is placed in the working position as in-

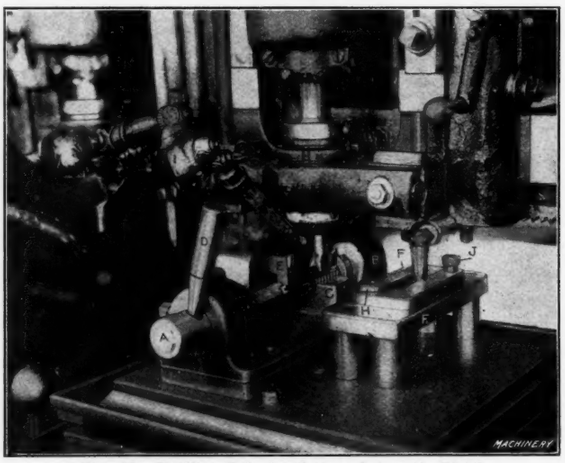


Fig. 13. Profiling Bolt for Savage Automatic Pistol

dicated by the dotted lines. The same pin *H* is also used for locating this plate. The second cut *B* is now taken, the guide-pin following path *b*. The hook shaped end *J* on the former prevents the cut from running out at *K*. The long guard plate *H* (see Fig. 11) at the side of the former prevents the operator from moving the cutter over into contact with the left side of the former base. By having guards of this kind, the operator can shift the cutter-slide rapidly and without fear of feeding the cutter against some part of the work or fixture. The slide is located in the fixture by pin *L* at the end and the three half pins along the right edge, and it is held by a single clamp which is cut away and beveled to clear the cutter.

### Profiling Bolt of Automatic Pistol

An interesting profiling fixture and former is shown in Fig. 13. The operation is on the bolt of the automatic pistol and consists of beveling the corners *M* (Fig. 17) of the opening and cutting a round groove, as shown by the shaded area *N*. The bolt is held between the plug *A* and the end *B* of the fixture, and it rests on block *C* which has a circular seat. End *B* is counterbored to receive the end of the bolt, and plug *A* has a pilot or small projecting end which enters the bore of the bolt. Lever *D* attached to plug *A* passes through a cam slot (similar in form to a bayonet lock) and is used to force the bolt back into the counterbored seat in block *B*. The opening or channel which is to be beveled is located in

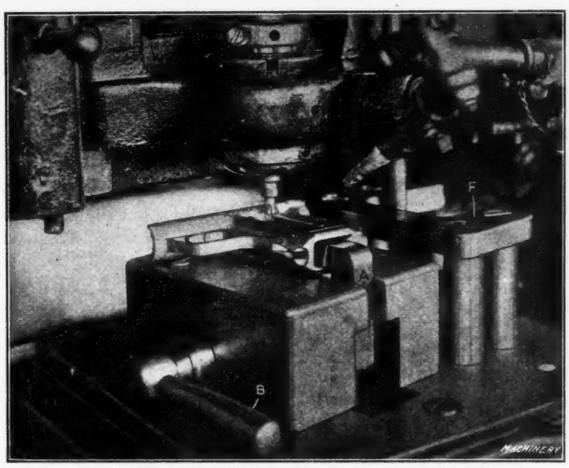



Fig. 14. Profiling Dovetail Seat for Side Plates of Pistol Frames

a central position by a close-fitting finger *E* which is turned down into the opening by lever *G*.

A double former plate is used for this operation. When beveling edges *M*, plate *F* is in the working position as shown by Fig. 13 and by the full lines in Fig. 17. This plate swivels about screw pin *H* and is located by pin *J* which passes through it. When the edges have been beveled by the tapering cutter used for this operation, the other spindle carrying a cutter of different shape is moved over to the working position and plate *F* is swung back as indicated by the dotted lines (Fig. 17). The lower slot in the main former $F_1$ is then used for profiling the seat *N* at the bottom of the bolt.

### Profiling Dovetail Seat for Side Plates of Pistol Frame

The vulcanized rubber side plates for the handle of a Savage automatic pistol are inserted into close-fitting dove-

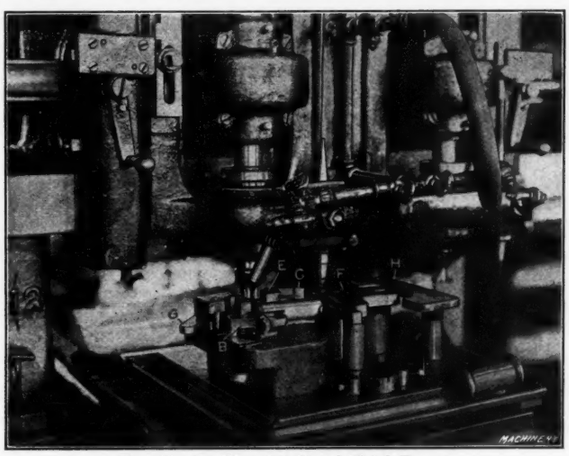



Fig. 15. Profiling Outside of Pistol Frame

tail seats. Figs. 14 and 18 illustrate how these seats are milled on the profiler. The frame is located by two circular bosses on the lower side which enter holes in the base of the fixture. (These bosses are used to locate the frame for practically all operations, thus insuring accuracy as to the relation between the different surfaces. After the frame is finished the bosses are removed.) The frame is clamped downward against the fixture by hook bolts *A* (Fig. 14) at

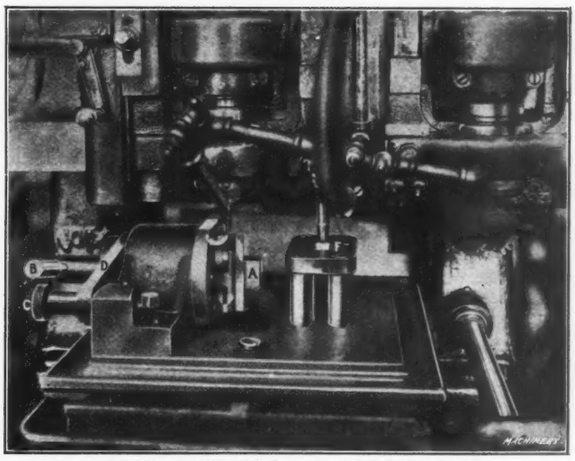



Fig. 16. Profiling Fixture of the Indexing Type

each end. These bolts enter the magazine opening and the lower ends are attached to a connecting bar that is forced downward by a cam lever *B*. An angular cutter is used and the cut extends across the bottom of the handle, then along the front side and out across the top. The former *F* is open

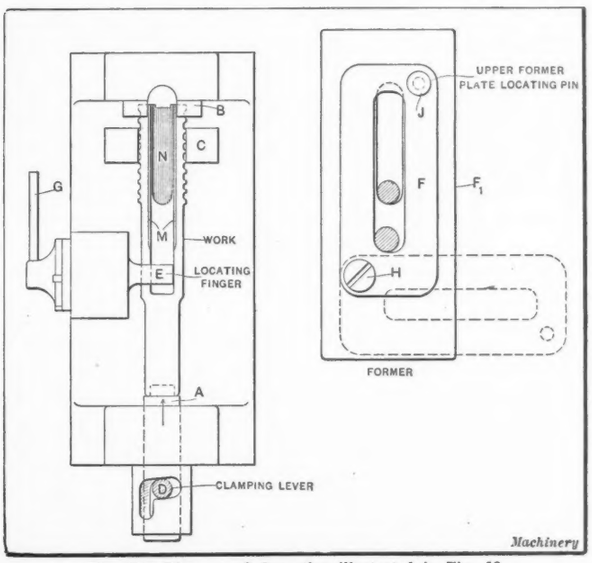



Fig. 17. Diagram of Operation illustrated in Fig. 13

on the right-hand side so the guide-pin can enter while the cutter is in the working position.

The fixture used for milling the dovetail seat on the opposite side of the frame is similar to the one just described, except that the method of locating the work is different be-

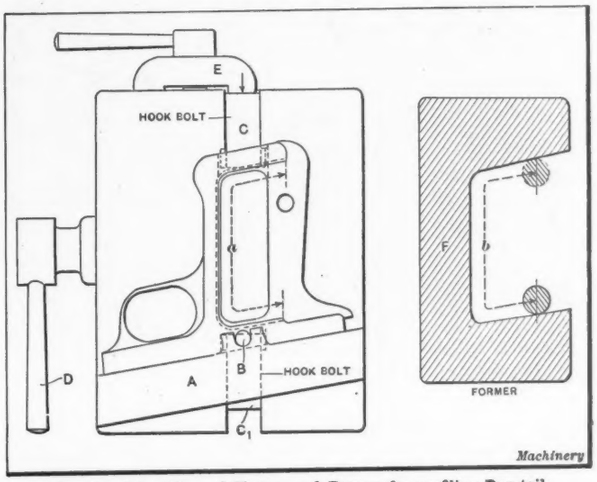



Fig. 18. Plan View of Fixture and Former for profiling Dovetail Seat on Right Side of Pistol Frame

cause the circular bosses previously referred to are now on the upper side. A plan view of this fixture is shown by the diagram Fig. 18. The frame is located by the angular strip *A* and the boss *B* on the side of the frame, which enters a circular seat in the projecting lug shown. The frame is clamped against the bottom of the fixture by two hook clamps *C* and $C_1$ which are operated by a cam lever *D* the same as the clamping bolts on the fixture illustrated in Fig. 14. To

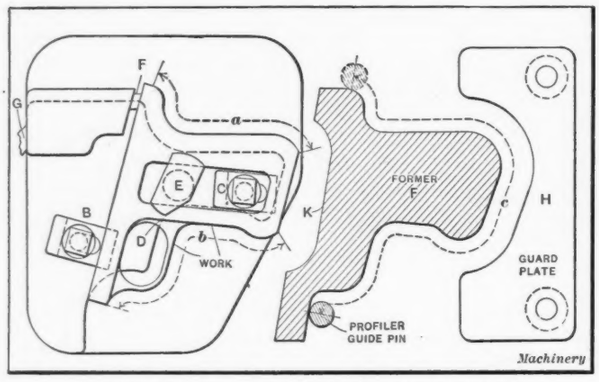



Fig. 19. Plan View of Profiling Fixture shown in Fig. 15

insure contact between the frame and the end strip *A*, bolt *C* and the work is forced against *A* (as indicated by the arrow) by tightening clamp *E*.

The path followed by the cutter is shown by arrow *a* and the movement of the guide-pin along the former *F* is indicated by arrow *b*. Roughing and finishing cuts are taken. The cutters are small and revolve very rapidly. The actual time required for taking one of these dovetail cuts is only about five seconds.

### Profiling the Outside of a Pistol Frame

The former and fixture used for milling the outside of an automatic pistol frame are shown in Fig. 15. The cut extends down the handle on one side as indicated by arrow *a* (Fig. 19) and is then continued on the opposite side and around the trigger guard as shown by arrow *b*. (The side of the trigger guard and surface *D* is finished by a separate profiling operation.) The frame is located by the bosses on the lower side which engage holes in the fixture base, and it is held by clamps *B* and *C*, the T-head bolt *E* and the plunger *F* which is pushed in between the top sides of the frame by lever *G*.

The cutter is concave for producing round edges, and roughing and finishing cuts are taken. The former *F* has a guard plate *H* on the right side. When cut *a* is completed and the guide-pin and cutter are being moved past the end of the

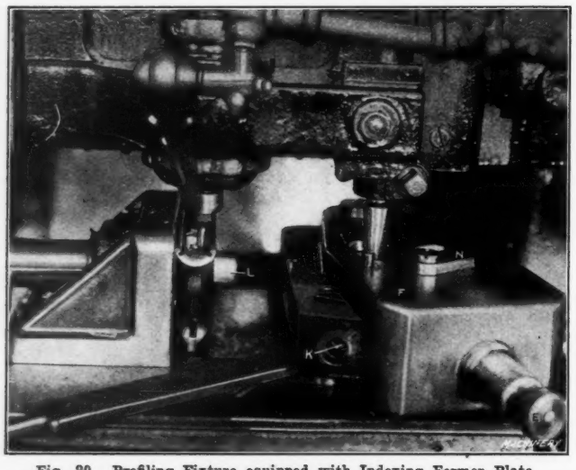


Fig. 20. Profiling Fixture equipped with Indexing Former Plate for Double Operation

handle to the opposite side for taking cut *b*, this guard plate prevents the slide and cutter from being moved far enough to the right to cause the cutter to strike the former along the side *K*.

### Indexing Type of Profiling Fixture

A profiling fixture of the revolving or indexing type is shown in Fig. 16. The operation is that of milling the top and bottom ends of the magazine opening in the pistol frame, to a depth of about ¾ inch. The frame is located on the circular faceplate of the fixture by the locating bosses previously referred to and it is held by a T-head clamp bolt *A* which passes through it and is tightened by the handle *B*. When one end of the magazine is milled, plunger *C* is withdrawn and arm *D* with the work, is turned a half revolution by swinging arm *D* over to the opposite side of the fixture, where plunger *C* engages another hole thus locating the frame for the operation on the opposite end of the magazine opening. The profiling operation is simply that of forming a plain rectangular surface, former *F* being used to guide the cutter. The metal between these milled surfaces at the ends is afterward removed by a shaving operation in the shaper.

### Profiling the Sear Trip Seat in Pistol Frame

The profiling operation illustrated in Fig. 20 is that of forming the sear trip seat in an automatic pistol frame, and the surfaces above the sear trip seat. The nature of the operation is illustrated by the diagrams *A*, *B* and *C* in Fig. 21, which also shows a plan view of the fixture. The sear trip seat, which is about ¼ inch deep, is formed by two separate cuts as shown by the views *A* and *B;* the surfaces above this seat, which are represented by the shaded area at *C*, are then milled.

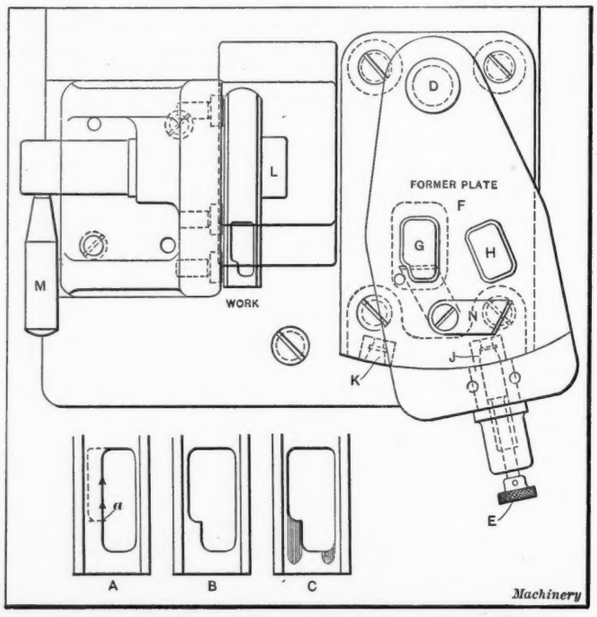



Fig. 21. Plan View of Fixture having Indexing Former Plate

A cutter in one spindle is used for the sear trip seat, and another cutter in the other spindle for milling the top surfaces. The former plate *F* contains two guide-pin holes *G* and *H*. Hole *G* is used when profiling the seat (as at *A* and *B*) and hole *H* for the other operation, the former plate *F* being indexed to locate either of these holes in the working position. This plate swivels about the screw pin *D* and is located by the spring plunger *E* which enters holes *J* and *K* in the former base.

The frame to be profiled is held against an angle-plate (attached to the base of the fixture) by T-head clamp bolt *L* which passes through the frame and is tightened by lever *M*. The bosses on the side of the frame engage holes in the angle-plate and locate the frame in the proper position. When milling the seat, the former plate is in the position shown in Figs. 20 and 21; that is, with plunger *E* engaging hole *J*, thus locating the former hole *G* in the working position. The cutter is dropped down to the proper depth by the vertical locating device for the spindle slide which was referred to in connection with Fig. 10. The guide-pin is then traversed around hole *G* but when it reaches the corner *a* (see detail view *A*) the movement is continued along a straight line, as indicated

by the arrows, thus forming a rectangular slot as the diagram shows.

The auxiliary plate *N* on the former is then swung across the end of hole *G*, as shown by the dotted lines, thus blanking off this end. The seat is then finished as at *B*. If plate *N* were not used and the guide-pin simply followed the slot in the former, the corner at *a* would be rounding instead of square. The end of the plate *N*, however, causes the guide-pin and cutter to move straight in, thus milling a square corner.

When the sear trip seat is finished, plunger *E* is withdrawn and the plate is indexed to locate hole *H* in the working position, plunger *E* being engaged with hole *K*. A cutter in the opposite spindle, which is located at a higher level, is then used to mill the upper surfaces as indicated by the shaded areas in view *C*.

In practically all of the profiling operations described in the foregoing, both roughing and finishing cuts are taken. Some of the roughing cuts are quite heavy but the light finishing cuts which follow insure accurate and smooth surfaces. In the profiling department, as well as in other departments of the Savage factory, all parts are carefully inspected both by the "outside" department inspector, whose business it is to detect and prevent errors, and also by the regular inspectors, as was explained in a preceding article.

* * *

## TAYLORISM AND THE BONUS SYSTEM*

BY FRANK RICHARDS†

I am glad to note that the industrial journals, which have done so much for the promotion of the efficiency of machine tools and of manipulative processes, are now disposed to turn their attention to the worker himself, upon whom the ultimate success of all methods must depend. Just now the American industrial fad—and it is practically confined to America and must have its run here as other American fads do—is scientific management. The beginning of the so-called scientific management, which is still much more written about than practiced, is Taylorism, which has been spoken of in *The Engineer*, London, as "a peculiarly hideous method of dehumanization," a characterization which I think fits it well. Far from having the ultimate effect of promoting industrial conditions in the interest of either employer or employe, it deliberately brings about the degradation and belittlement of the individual American workman, it is inimical to the development of skill and paralyzes all incentive.

It is fortunate for the system that it has had many and zealous advocates whom Mr. Taylor has hypnotized—I use the word deliberately—who have written voluminously concerning the workings of the system, and have spread their own stories as to what has been accomplished under it, while few or none have had the time or the interest to put forth their views and experiences in opposition, so that Taylorism and so-called scientific management stand before the public almost entirely upon *ex parte* testimony, and it would seem that any honest statements of opposing views should not be too hastily squelched.

Speaking now a little more precisely: Under the Taylor system the doing of all work is to be planned in detail for the workman, and every move he is to make in doing a certain job is prescribed for him, with or without the time in seconds for each motion. This schedule is to be followed absolutely. Mr. Taylor has said before the American Society of Mechanical Engineers that the workman should be required to do his work so exactly as prescribed, that if at any time he saw a quicker or a better way of doing the work, that way must be ignored. I do not know that Mr. Taylor has ever said that the less a man knows about his work the better, but the man who knows nothing at all would seem to be his ideal workman. What incentive could there be under the Taylor system for any man to do with his might what his hand found to do?

* For other articles on scientific management, the bonus system, and allied subjects published in MACHINERY, see also "Some Good Results Obtained by the Bonus Plan," by W. L. Myles, December, 1912; "Industrial Administration and Scientific Management," by F. E. Cardullo, July, August and September, 1912; "Scientific Management from a Social and Economic Standpoint," June, 1912; "Industrial Efficiency," by H. L. Gantt, May, 1912; "Task Work—the Basis of Proper Management," December, 1911; and "The Utilization of Labor," by H. L. Gantt, April, 1907.

† Address: 229 W. 135th St., New York City.

### The Bonus System

Another fundamental feature of scientific management which is much bragged about is the "bonus system of rewarding labor." A self-respecting workman never wants to be rewarded, but just honestly paid for his work. The bonus system dodges the honesty. It is a singular fact that, so far as I know, only machinists and workers in trades allied to them, have been regarded as such simpletons as to make it safe to propose the bonus system to them. Of course, no one has ever had the hardihood to propose the bonus system of rewarding labor to the collar girls of Troy, to the glove workers of Gloversville, to the hat makers at Danbury, at the knitting mills of Cohoes, the textile mills of Lowell, Lawrence and Fall River, nor among the garment workers of New York. In such places as these the worker is paid for just what he does, and according to the amount of work accomplished. If he is paid a certain sum of money for a specified quantity of work he is paid 50 per cent more money for 50 per cent more work, and so on according to the work done.

Under the bonus system a certain rate of pay is fixed for a certain amount of work done in a given time, say a day; then if the man does more than the stipulated amount in the given time, entirely through his own exertions and with the employer getting the benefit of the increased productivity of his plant, he is not paid at the same rate for the additional amount of work done, but is given a "bonus" amounting usually to one-half—sometimes less and seldom more—or the additional amount fairly earned. To put it in plain figures: if a man is paid $3 for producing 100 pieces of a certain product in a given time, he should be paid $4.50 if he produces 150 pieces in the same time; and he would be paid at that rate under the system ruling in the factory towns above mentioned. Under the "bonus system for rewarding labor" he would be paid $3.75 or less. It is astonishing that such a system should have had even temporary acceptance anywhere. If I misrepresent the system in any way I would be glad to be corrected. If the system is essentially honest I would like to have it proved to me.

* * *

## GRAPHITE AS A LUBRICANT FOR BALL BEARINGS

Experiments conducted by Prof. W. F. M. Goss indicate that a combination of graphite and lard oil makes a lubricating mixture which, when applied to ball bearings, will accomplish everything that lard and oil will do, and which, at the same time, gives a lower frictional resistance and permits a large increase in the load which the bearings will carry. Kerosene or light oil, when mixed with graphite, is stated to be an effective lubricant for ball bearings operated under light or medium pressures. An English ball bearing manufacturer points out, however, that in his experience the use of graphite for the lubrication of ball and roller bearings is detrimental, because graphite will, in the long run, lap away the surfaces of the balls and races and destroy the bearing. Ball bearings, he says, require no lubrication in the ordinary sense of the term, but it is very essential that a greasy film be present over the bright steel parts to prevent rust. Pure mineral grease of the consistency of vaseline is recommended by this manufacturer for that purpose. This grease must be free from acid and should not attract moisture from the atmosphere.

* * *

## SUBMARINE POWER CABLE

The submarine cable recently laid between Sweden and Denmark will enable electric energy obtained from Swedish water falls to be sold in Denmark. The sound which divides the two countries is only between five and six miles wide at the narrowest point where the electric power cable is laid. The current is transmitted from the power stations to a point on the Swedish side of the sound at 50,000 volts. At this point it is transformed to 25,000 volts and transmitted by an underground cable three miles long to the coast line, where the submarine cable conveys the current across to the Danish coast; from there it is transmitted for about a mile by an underground cable and then again transformed to 50,000 volts. From this point, the current is carried to Copenhagen by overhead conductors.

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Chester L. Lucas, Edward K. Hammond,
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NOVEMBER, 1914

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## NEW EUROPEAN TRADE ALIGNMENTS

Some statistics of the machine tool industry in Europe are particularly interesting at present, and induce us to consider whether this trade after the war will revert to its old channels or find new ones. The total value of German machine tools manufactured during recent years has been estimated at $55,000,000 annually, of which $15,000,000 represents the exports. Russia, Austria and France have alone taken about one-half of these exports—Russia about $3,000,000, France about $2,500,000. Great Britain has also bought heavily of German machine tools.

The total exports of all kinds of machinery from Germany have recently exceeded $250,000,000 a year, and of these exports the largest proportion has gone to Russia. There being no Russian machinery manufacturers to compete with, the prices obtained there are unusually satisfactory. The Russian machinery building industry will develop slowly, so that country will continue to import both machine tools and general machinery for many years to come, and of all the foreign machinery markets none is larger nor more promising.

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## THE IMPORTANCE OF TOOL EQUIPMENT

During the past ten or fifteen years, in which machine tools and machine shop practice have been highly developed, many features have been introduced which have made it possible to obtain not only a greater output, but one with much closer limits of accuracy than before. In certain lines, the possible increase in output is so marked as to exceed all expectations of a dozen years ago. However, accuracy and capacity of machine tools are not the only requirements for obtaining the best results as regards both quality and quantity of output. The machine tool may be almost perfect, and yet comparatively little is gained if the methods of holding the work and presenting the tools to it are not up to the standard of the machine itself; but these factors are neglected in many machine shops, and the high quality of the product made possible by the machine is not obtained. It is true that many machine shops have planning departments where efficient tools are designed and where the methods and appliances which are to be used in the manufacturing work are carefully considered, but in most shops the workmen, with or without the assistance of the foreman, still are left to devise for themselves the methods by which the work is to be held and machined, especially in the case of turning and boring operations.

With exceptionally skilled workmen, this method may answer, but in the majority of cases, especially in interchangeable manufacture, where the men are trained in the use of but one machine, it is seldom possible for the machinist to obtain the experience necessary to consider both the accuracy required and the best means for rapid production. A designer especially detailed to do this work will be able to accomplish much better results.

Whether the planning of the tool equipment is done by a designer employed entirely on this work, or by the foreman and machinists, the articles on tools, arbors, chucks, fixtures and other holding devices, which have been published monthly in MACHINERY during the past year, will be found of great value. These articles describe fundamental principles and constitute the most nearly complete descriptions of tools and devices for turning and boring operations ever published. In addition to the articles applying specifically to lathe and boring mill work, attention will be paid in this series to the design of tools and holding devices with reference to their first cost and the cost of keeping them in repair —considerations which are of prime importance in economical shop management.

A very important feature of these articles is that the devices shown and described are examples of designs actually employed in practice and successfully applied to productive work in a great number of manufacturing establishments. There is nothing of the theorist in Mr. Dowd's methods of describing the tools, chucks and fixtures dealt with. The descriptions are plain, matter-of-fact statements, and should therefore appeal with especial force to the great body of men of practical training who are seeking specific and up-to-date information. The articles fill an obvious gap in existing mechanical literature and are of unquestionable permanent value.

* * *

## IMPORTANT PATENT LEGISLATION

The Senate of the United States has amended the Clayton anti-trust bill, now pending, by forbidding contracts relating to patented articles that contain a provision requiring the purchaser or licensee of a patented device to use any article not protected by the patent, or restricting him from using any article not so protected. Parties to such contracts are liable to a fine of $5000 and imprisonment for one year. The object of this legislation is to prevent agreements between manufacturers, dealers or owners of patents and the users of same, by which such articles may be sold only on condition that the customer uses with them supplies that are also furnished by the manufacturer. The provision is partly an outcome of the famous Dick mimeograph patent case, in which it was decided by the Supreme Court that the users of the patented mimeograph could be prevented from using any other ink or supplies than those sold by the manufacturers. It is evident that if this decision were allowed to remain a precedent, owners of patents could control beyond reasonable limits the sale of supplies for use in connection with patented apparatus, and the amendment is a wise one. There is, however, a tendency toward legislation forbidding trade agreements which apply to patented articles, while similar agreements applying to non-patented articles are allowed. Legislative control should apply to both patented and non-patented products.

* * *

## HIGH-SPEED DRILLING

A phase of drilling practice which has received comparatively little attention until recently is that concerning the production of very small holes. Plenty of drilling machines have been built for quickly drilling holes from one-quarter inch diameter up, but few that would drive a drill at efficient speed in the very small sizes. The law of efficient drill action holds approximately true for any diameter of drill. If a high-speed steel drill of one inch diameter should be driven at the rate of 300 revolutions per minute, or at a peripheral speed of 80 feet per minute, then a drill 1/32 inch

in diameter should be run at the rate of nearly 10,000 revolutions per minute to attain the same peripheral speed. But this speed was practically impossible with the drilling machines having plain spindles, indifferently balanced pulleys, and other defects tolerable in comparatively slow-running machinery.

The new type of drilling machine capable of driving the smallest commercial twist drills at efficient speeds is a highly specialized tool, built with the precision of a watch and accurately balanced throughout. Ball bearings provided for taking thrusts rather than radial loads on the spindle are features of novelty to the machine designer and user. The result of intelligent design and high-grade workmanship is that holes so small that they can be drilled with ordinary machines only by painstaking care, and then at the cost of many broken drills, are being drilled at "punching machine" speeds. Girls working at piece rates which enabled them to earn $1.25 to $1.50 a day were able to double their earnings with the new machines.

A feature of high-speed drilling requiring accurate balancing is the drill chuck. The ordinary drill chuck balanced for speeds of 2000 to 3000 revolutions per minute was found to be out of balance at 10,000 revolutions per minute and great care had to be taken to secure perfectly balanced chucks before satisfactory results could be obtained. The case is interesting because the drilling machine has been regarded as a simple tool that could be built anywhere by cheap labor. The fact is that it is a machine requiring the best design and workmanship in order to produce efficiently, especially in the small sizes.

* * *

## DOMESTIC BALL BEARING MANUFACTURE

The adage, "It's an ill wind that blows nobody good," applies to the European war with reference to several American industries, among which might be mentioned the manufacture of ball bearings. Previous to the declaration of war German makers possessed several advantages, including lower labor cost, and had become important factors in supplying the American trade. Our makers of automobiles and other products in which ball bearings are used then found their supplies suddenly cut off; but American manufacturers quickly rose to the situation and are providing for the manufacture of balls and ball bearings in America that will equal in every respect the best foreign products. Grinding machines of a semi-automatic character are being developed here which will greatly reduce manufacturing costs, and improved machinery is being made which will turn out balls as cheaply as the German product, and within limits of one ten-thousandth inch.

The advantage of low-priced labor formerly possessed by foreign manufacturers is likely to be lost with the conclusion of peace. Some of the least of the misfortunes which follow war will be increased living expenses and excessive taxation, which will work out in higher manufacturing costs.

* * *

## ATMOSPHERIC CONDITIONS IN FACTORIES

More and more attention is being given by architects and factory engineers to the atmospheric conditions in shops, mills and factories, with special regard to their effect on the workers. The time is long past when manufacturers believed that employes could work efficiently in unheated shops during cold weather, or that they should hustle and keep warm by bodily exertion. Men produce the most and are best contented when working in comfortable surroundings; but heating a shop in winter is not all that can be done to contribute to suitable atmospheric conditions. Not only should the air be at a temperature of, say, 65 degrees in winter for comfortable work, but it should not vary much from that temperature in summer. In other words, the highest efficiency will be attained when the temperature conditions are practically equable throughout the year. To preserve uniform conditions, the windows and doors must be closed the year round and the air heated in winter and cooled in summer.

Not only should the air supplied to workrooms be heated or cooled, but it should be tempered also as regards the moisture content. A great deal of the bodily discomfort experienced in summer is caused, not by high temperature, but by humidity or mugginess. A highly humid atmosphere has low moisture-absorbing capacity, and perspiration dries slowly; hence the excess heat in the body is not rapidly dissipated. It is therefore desirable that the air be supplied to workrooms not only at a uniform temperature, but in a uniform hygroscopic condition.

An incidental advantage of a hermetically sealed workroom in which the air is supplied by forced draft through hygroscopic tempering appliances is the elimination of dust. Dust in factories is an annoyance, and has a serious deteriorating effect on many goods. It gets into the bearings of machines and causes excessive wear; it destroys fine finish and contributes to the ill health of workmen.

An ideal plant of the future evidently will be that in which windows are hermetically sealed and doors are always closed. The air, supplied at uniform temperature throughout the year, will be moistened when too dry and relieved of its excess moisture when too wet. Dust will be eliminated and the future workroom will thus be made a dustless place of ideal temperature and hygroscopic conditions.

* * *

## STARTING RIGHT WHEN STANDARDIZING DESIGNS

The internal combustion engine is one of the most interesting of prime movers. Though simple in its essential make-up, it offers many unusual problems in design to both the theoretical and practical man. The one element of valve operation presents a valuable study in pure and applied mechanics. The engine of the multiple-cylinder type universally used in automobile construction presents problems of cam-shaft design and construction which have interested some of the best mechanical talent.

Cam-shafts having the inlet and exhaust cams integral with the shafts are ground to shape on grinding machines fitted with attachments that insure uniformity of outline and angular position. Not all designers agree on what are the best shapes and the most advantageous angular positions of the cams. These depend to some degree on the design of the cylinder valves and connections, but whatever form of cam-shaft is adopted efficiency of manufacture requires that a standardized product shall be produced. In short, every cam-shaft shall be alike and strictly interchangeable.

To produce accurately shaped and positioned cams by methods worked out by the grinding machine builders is now a comparatively easy matter, but the interchangeable product has not always given immediate satisfaction to the automobile manufacturers, strange as it may appear. The reason is that the standardizing process did not start from the right point. The manufacturer's method was to design and build a motor and adjust it so that its functions were performed as perfectly as possible. The cam-shaft was then taken as the pattern for the engine to be manufactured. Drawings specifying the shape and angular positions of the cams were submitted to the grinding machine builders with orders to design the cam grinding attachment so as to produce an exact copy.

The trouble with this procedure was that any lateral deviation of the roller or mushroom lifters in a plane at right angles to the cam-shaft would affect the timing. That is, a lateral displacement of the lifter was equivalent to a change of angular position of the cam. Hence it was necessary that the model engine should be built with the lifters dead in line in a plane parallel with the cam-shaft axis. If that condition did not exist in the model, the standardized cam-shaft would be bound to give results different from those obtained from the model.

This illustrates how necessary it is in standardizing any machine to make sure that all its working elements bear certain fixed relations to points, lines or planes that will be the natural ones to work to in manufacturing.

* * *

There are 3600 plants in the United States melting brass and bronze, and 1000 of these melt non-ferrous alloys exclusively.

# MACHINE FORGING GEAR BLANKS*

## DIES AND METHODS USED IN MAKING VANADIUM STEEL GEAR BLANKS IN THE FORGING MACHINE

BY DOUGLAS T. HAMILTON†

The working of high-speed and alloy steel in the forging machine is a comparatively recent development, and is one of the many indications of the universal adaptability of forging machines to the production of machine and miscellaneous parts. When a forging machine can be utilized, the production is much greater than when a steam hammer is used, and the manufacturing costs are also much less. Fig. 1 shows a vanadium steel gear blank that is produced in two operations in a 4-inch Acme forging machine in the plant of Dodge Bros., Detroit, Mich. This gear blank, as the illustration shows, is made from a 2½-inch bar of vanadium steel without any waste of stock whatever, at the rate of 1100 in eight hours. *A* shows the bar and gives some indication of the amount

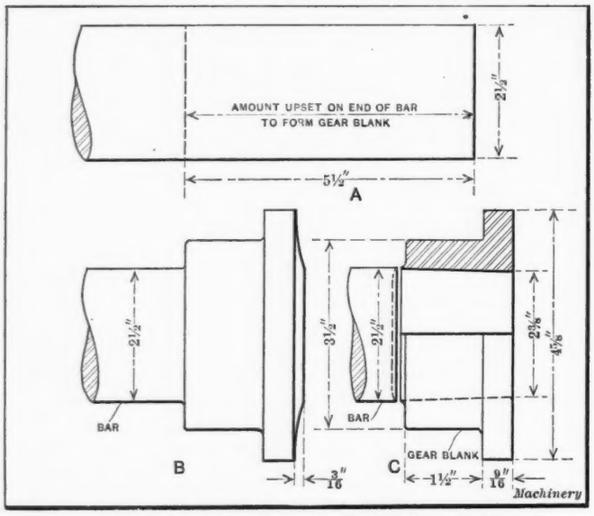



Fig. 1. Diagram showing Sequence of Operations employed in producing a Gear Blank in the Forging Machine

of stock necessary to form the gear blank, while *B* shows the blank after it is upset in the lower grooves of the forging machine dies, shown in detail in Fig. 4. *C* shows the completed gear blank and illustrates how it is produced without any waste of stock.

### Methods Followed in Forging the Gear Blank

The method of forging vanadium steel gear blanks is to first heat the 2½-inch bar of vanadium steel in the furnace shown to the right in Fig. 2 to a temperature of about 1700 to 1800 degrees F. The bar is then quickly removed from the furnace and placed in the lower impression *A* of the forging machine dies shown in Fig. 3. The machine is then operated, and as the lower plunger *B* advances it upsets the bar and

* For articles on machine forging previously published in MACHINERY, see "Forging and Machining Automobile Front Axles," December, 1913, and the series on machine forging published in MACHINERY, April, May, June, July, September, and October, 1913.

† Associate Editor of MACHINERY.

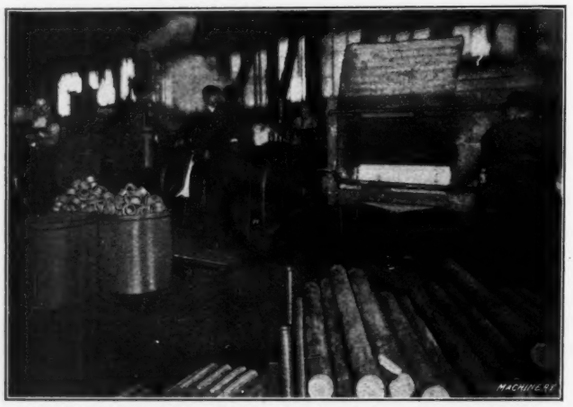


Fig. 2. Acme Forging Machine in Operation on Vanadium Steel Gear Blanks. Eleven Hundred are turned out in Eight Hours

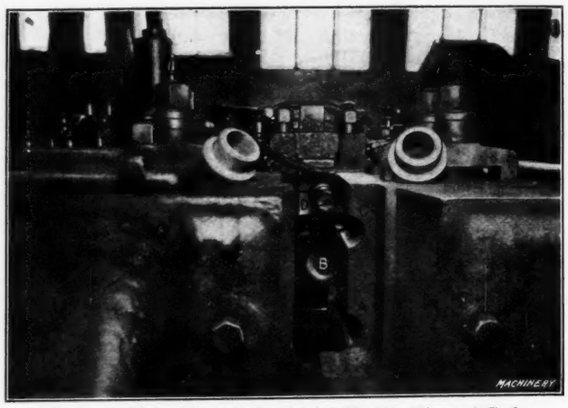


Fig. 3. A Closer View of the Forging Machine Dies and Tools

forms the gear blank on the end of it, as shown at *B* in Fig. 1. The upsetting of the bar cools it to such an extent that great difficulty would be experienced in punching the hole in this initial heat. The bar is therefore returned to the furnace and reheated. While it is being reheated, another bar is removed from the furnace, and the ends upset or the hole punched, depending on how far the forging operations have been carried.

As soon as the upset bar has been reheated to the proper temperature, it is removed from the furnace and placed in the upper impression *C* of the gripping dies, as shown in Fig. 3. The forging machine is again operated, whereupon the ram advances and the top plunger *D* forces a hole in the end of the bar, and at the same time carries back the metal removed to form the hole, and attaches it to the end of the bar. This, of course, is done in one stroke of the forging machine. The upsetting generally requires two blows, the number of blows depending entirely on the temperature to

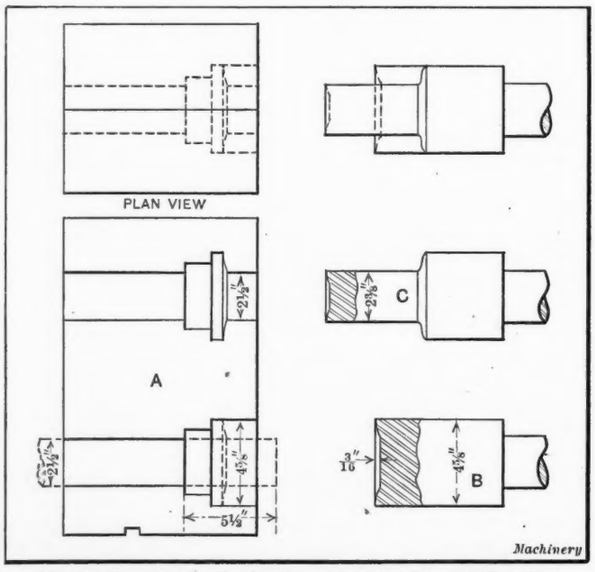



Fig. 4. View showing Construction of Gripping Dies and Upsetting Plungers for making Vanadium Steel Gear Blanks without Waste of Stock

which the metal has been heated before being placed between the gripping dies. The second blow on the blank compresses the metal and makes a more homogeneous mass. It also eliminates flaws or fissures in the forging.

### Construction of Dies and Punches for Forging Gear Blanks

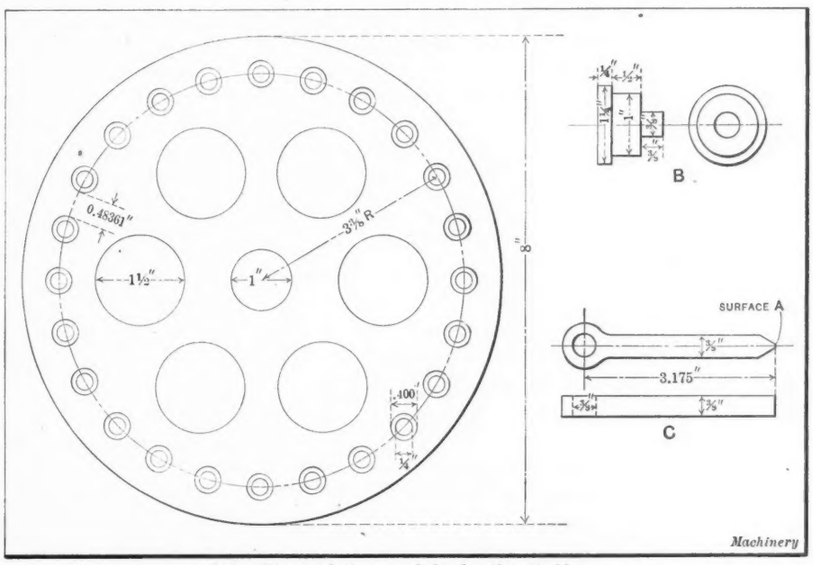
Fig. 4 shows an elevation and plan view of the forging machine gripping dies and plungers. By referring to this illustration it will be seen that the lower impression in the gripping die is made to the approximate size of the gear blank, the larger hole being counterbored considerably deeper than the thickness of the flange on the gear blank. This is to provide a support for the plunger when upsetting the metal. It will also be noted that the plunger *B* is cup-shaped or re-

cessed on the front end. There are two reasons for making the punch in this manner. The first and most important is that it enables a gear blank with a straight front face to be produced. If the front face of the gear blank were made square when the bar was upset, it would then become concave when the hole was puhched. The reason for this is that the hot metal would be drawn in by the piercing plunger *C*. By providing the upsetting plunger with a concave face, a convex boss is formed on the face of the gear blank. Then when this bar is reheated, and transferred to the upper impression in the gripping die, it is held rigidly as the illustration indicates, while the piercing plunger *C* advances and forms the hole in the gear blank.

It will also be noticed that the concave impression in the upsetting plunger *B* also helps considerably in centering the bar, thus preventing it from buckling or pushing over more to one side than the other. The upper piercing plunger *C* is also provided with a concave face. The reason for making the piercing plunger in this manner is to reduce the amount of pressure required to force it through the heated blank. It also provides for a better shearing action of the plunger. It will be noticed that the plunger is ⅛ inch smaller in diameter than the hole in the gear blank or the diameter of the bar. This also reduces the pressure required to force the plunger through the heated blank. Fig. 1 shows very clearly the resulting gear blank. The hole at the larger end is 2⅜ inches in diameter, whereas on the rear face, where it was attached to the bar, the hole is the same size as the bar or 2½ inches in diameter. This makes a tapered hole, but as it greatly reduces the amount of power required to form the hole in the gear blank, the taper is of minor consideration; in any event, it has to be machined to the correct dimensions after forging.

### The Possibilities of Machine Forging

The producing of a vanadium steel gear blank in a forging machine is an indication of the possibilities of machine forging. While it is generally known that a forging machine is adapted to the making of wrought iron and soft steel parts, it has not been considered in the past practicable to produce high-carbon or alloy steel parts in this manner. Of course it requires a much more rigid and heavily constructed forging machine for working vanadium and alloy steel than it does for soft steel and iron. In the most up-to-date forging machines, however, of which the Acme is a good example, the bed of the machine is made from one solid steel casting. This is so proportioned that all strains are taken up in the bed itself, thus relieving any unnecessary strains in the dies or tools. If the gripping dies are not rigidly supported while the bar is being upset, they will spring away and produce flash or fins on the work. A positive gripping mechanism, therefore, is absolutely necessary if good clean work is to be expected from a forging machine. It will be seen from the two gear blanks lying on top of the machine in Fig. 3, however, that these are produced without any fins whatever, except a slight burr around the hole, which is practically unavoidable. The forging is just as clean as could be produced under a steam hammer, and furthermore, it does not have to be trimmed. There is also some waste of stock in a steam hammer, as considerable metal is lost due to the removal of fins and flashes that are formed in the striking up of the forging.




Index Plate and Gage used for locating Bushings

## MAKING AN INDEX PLATE

BY JOHN MAHON

Various methods are employed for making index plates, and while most of these have certain features to commend them many are open to criticism on the ground of being exceedingly expensive, or else because the results produced are inaccurate. It is the purpose of this article to describe a method that the writer used in making an index plate which gave very satisfactory results, as regards both accuracy and cost of production. The common type of index plate with tapered slots is inaccurate in operation, because dirt is likely to get into the slots on one side of the plunger. Another drawback is the great expense involved in making a plate of this type where the wearing surfaces are hardened and where extreme accuracy is required. Such a plate must be made with segments fastened to one side of the outer edge, which entails a vast amount of work in grinding and locating the segments.

The index plate shown in the illustration is accurate, because any foreign matter is pushed out as the plunger enters the bushing. The plate is also comparatively inexpensive when its extreme accuracy is taken into consideration. In the event of the bushings becoming worn through use, they may be easily replaced at small expense and without impairing the accuracy of the index plate. This plate was made from the rough cast-iron blank and carefully finished to bring the sides parallel and the center hole perpendicular to the faces of the plate. Six holes 1½ inch in diameter were next laid out and drilled in order to lighten the plate and improve its appearance. The next step was to make the twenty-four bushings, which were hardened and lapped to a diameter of 0.250 inch on the inside, and ground and lapped on the outside to a diameter of 0.400 inch, great care being exercised to get all of the bushings exactly alike. The holes in the index plate were then laid out to approximately the required positions, using dividers for this purpose, after which the holes were drilled and tapped for each division to receive a 10 by 32 screw. The plan was to use the bushings as buttons and set all of them up at once.

A stud of the form shown at *B* was now made, this stud being hardened and then ground and lapped to an accurate fit in the hole at the center of the plate. A piece of the form shown at *C* was then made to be used in gaging the location of the buttons as regards their distance from the center of the plate. This gage was first made with a wing extending out on both sides of the center hole in order to facilitate measuring the surface *A* from the center. One wing was removed after the gage was finished. The gage was hardened and ground on one side and the hole was ground out while it was clamped to the faceplate on the finished side. The surface *A* was then ground on a universal grinder with the gage held on an arbor to bring the surface *A* exactly 3.175 inches from the center hole. This hole was made of such a size that it fitted accurately over the small diameter of the stud *B*. A size block 0.48361 inch in size was then made for use in spacing the buttons with exactly the required distance between centers.

The buttons were now set up on the plate and extreme accuracy was readily obtained, using the size block for measuring between buttons and the "feeler" or gage *C* for measuring the distance from the center of the plate to each button. A little variation in the "feel" of the size block between different buttons, and also between different buttons and the central stud, was readily detected. When the buttons were all set up, the plate was ready for boring. A stud was made 1/16 inch thinner than the plate and 7/8 inch in diameter. A hole was drilled through the center of this stud and tapped to receive a 5/8-inch cap-screw which was used to fasten the stud to the faceplate of the lathe at approximately the correct distance from the center of the spindle. The cap-screw extended through from the back of the faceplate and protruded sufficiently beyond the index plate to provide for using a strap and nut. The purpose of this stud was to facilitate changing from one button to another after completing successive holes, and to help eliminate the probability of buttons being accidentally moved. The stud was made a clearance size for the center hole in the plate in order to allow for truing up the buttons. This work was done with comparative ease, less than ten hours being required to bore the twenty-four holes, after which the buttons were pressed in and used as bushings for the index plate.

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## USE AND CARE OF CRUCIBLES

In a bulletin entitled "Brass-Furnace Practice in the United States," recently published by the Bureau of Mines, the author, H. W. Gillett, devotes a section to the use and care of crucibles. An abstract of this part of the book will prove of value and interest to all who have to do with the care of crucibles.

Although crucibles are free from moisture when removed from the kiln, they rapidly absorb it, and many take up 5 per cent of moisture during shipment from maker to user. If, instead of eliminating the moisture by a gradual annealing, the damp crucible is put directly into a hot furnace, or into a cold one and heated too rapidly, the moisture will be changed into steam so that the steam evolved will blow pieces of the crucible off bodily; that is, the crucible will "scalp." To prevent this, it must be raised from room temperature to a temperature somewhat above the boiling point of water very gradually, so that the moisture may be slowly driven off without "scalping."

### Crucible Storage

There is always an abundance of waste heat that can be utilized for warming the place where the crucibles are stored. A common place for crucible storage in foundries using pit furnaces is just back of the battery of furnaces. The waste heat may also be led through a special oven, so provided with dampers that the heat may be gradually admitted for annealing a fresh batch of crucibles. After annealing has been finished, the oven may be utilized as a warm storeroom. Crucibles are sometimes stored above a core oven, or, in a rolling mill, above an annealing furnace, a good practice if the oven or furnace is run constantly enough to keep the crucibles dry.

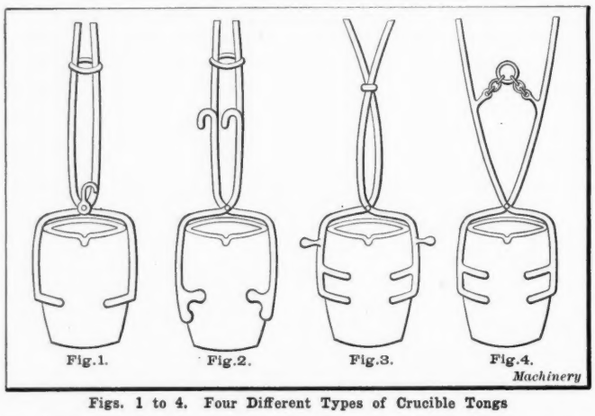
### Tongs Used for Crucibles

Most foundrymen are fairly careful about annealing their crucibles, but many do not pay enough attention to the tongs used and the way in which the crucibles are handled with them. The greatest damage is done with improper tongs or with tongs improperly handled. There are several different types of crucible tongs for pit furnaces, some of which are shown in the accompanying illustration.

Fig. 1 is a one-prong type, mainly used in pit furnaces burning anthracite coal, as in rolling mills. The prong comes just below the bilge, because the difficulty of poking tongs through the anthracite and its ash is greater than through coke and its ash, so that tongs that come farther down the crucible are more difficult to use in coal furnaces. The handles are spread, the tongs squeezed into place, and a link slipped over them to seat them tightly. A mechanical hoist operated by hand, air, or electricity is fastened into the hook at the pivot. Fig. 2 is of the spade type. It is shown with hooks on the handles for lifting the pot by hand without mechanical hoist. An iron bar is passed through the hooks and the pot lifted by two men, one on each side of the furnace.

Fig. 3 represents a two-prong tong, one prong being above and one below the bilge, with trunnions for pouring. In Figs. 1 and 2 the tongs are used merely for lifting the crucible from the fire and setting it into the pouring shank. In Fig. 3 the crucible is held by the tongs during pouring, being carried on a shank of such form that the shank may be held horizontal while the tongs are tilted on the trunnions; or, a bail may be attached to the trunnions and the tongs and crucibles held by a traveling crane. In the first three forms the crucible is pinched tightly in the tongs and the tongs are held in place by a link slipped over the handles. To put on the link and get it tight is "hot work," as it must be done directly over the open fire. Hence the furnace-tender, instead of slipping the link down just tight enough to hold securely, is prone to jam it down, even driving it with a poker or a skimmer. The pinching of the crucible may in this way be very severe, as the hot crucible is soft and leathery and gives somewhat readily. It is common to see crucibles the mouths of which have been pinched into a distinctly oval shape. Every time the crucible is thus strained it is weakened and its life greatly shortened.

To prevent this excessive pinching of types Figs. 1, 2, and 3, each of which may be termed the "pinch" type, the "grab" type, Fig. 4, has been devised. This is intended for use with a mechanical hoist, and may be made with one prong or with a spade prong if desired. In using the grab type the tongs




Figs. 1 to 4. Four Different Types of Crucible Tongs

are hooked into the hoist and lowered into place, the tongs being spread, and gently seated in place; the hoist is then slowly started upward, when the tongs take hold and the crucible is held by its own weight. A toggle joint may be used instead of the chain illustrated, and in some cases hooks like those in Fig. 2 are put on and the hoist carries an equilateral triangle, vertex down, which is hooked into both hooks and draws them down by the weight of the crucible. For use in oil or gas furnaces the grab type with a toggle joint may be further improved by making the joint with a pair of stop lugs, so that the tongs can open only far enough to clear easily the bilge of the crucible. The handles of the grab type are often bent down at right angles just above the chain, hooks, or toggle joint, so that the tongs may be guided into place without getting the hands directly over the open furnace.

Several foundries that use the grab type of tongs testify that with that type they can handle crucibles holding about 650 pounds of metal without difficulty. No instance of a crucible having been dropped by such tongs has been reported. Every firm using this type strongly favors it. This type seems to deserve a much wider use than it now has. No matter what type of tongs be used, if they lose their shape and do not fit the crucible at all points, excessive strain is put on the crucible at the points where they do touch. In the same way, the spade and two-prong tongs, having more bearing surface than the one-prong, divide the strain more evenly.

Some foundries have only one size of tongs, and if now and then they have to use a larger or smaller crucible than the

size ordinarily used, they will use tongs that do not fit. This practice is fatal to the life of the crucible. A crucible grows slightly smaller with use, owing to oxidation and wearing away of the surface. One foundry that reports an exceptional crucible life, has three sets of tongs, differing slightly in size, which are selected according to the age of the pot. An easy way to keep tongs in proper shape is to have a cast-iron form just the size of the crucible used. As soon as it is seen that the tongs are slightly out of shape they can be heated and pounded back into shape over the iron form.

### Care of Crucibles

An oxidizing atmosphere will burn the graphite from the outside of the pot and weaken it; hence for long crucible life in any furnace, especially in oil or gas furnaces, a reducing flame should be maintained. If an oxidizing flame is trained directly on the crucible, the crucible becomes badly scored at that point. As the burners requiring low-pressure air and high-pressure oil are more easily controlled so as to give a reducing flame, and as they usually give a wider cone of flame, as ordinarily operated, they are easier on crucibles than the burners using high-pressure air. If oil be allowed to spray strongly on a cold crucible before the burner is lighted, the oil will soak in, and "scalping" may result when the furnace becomes hot. Sulphur dioxide from fuels high in sulphur is said to be highly deleterious to the crucible.

Allowing the crucible to remain in the fire longer than is necessary, that is, not taking the pot out when the metal is ready, or allowing the metal to "soak," increases the wear on the crucible; hence promptness in taking out the metal lengthens the life of the crucible. The higher the temperature to which the metal is raised, the harder the wear on the crucible. In foundries in which alloys of several melting points are used, crucibles are usually used for part of their full life in melting an alloy with the highest melting point, and are then used for alloys with lower melting points. Thus a crucible might be used for a couple of heats of pure copper, then for phosphor-bronze, then for red brass, next for yellow brass, and finally, for aluminum. Used in this way, the total tonnage melted per crucible would probably be larger than if each crucible should be used for its full life on one alloy. Between changes in the alloy melted, it is necessary to clean the crucibles well from any adhering metal to avoid contamination from the previous charge. One way in which crucibles are injured is by wedging them full of cold ingots or scrap, which expand as they are heated to the melting point; the crucible does not expand so much, so that a great strain may be set up and the crucible be cracked, or at least, weakened. Crucibles may also be badly injured mechanically by carelessness in poking the fire or in knocking off slag and clinkers.

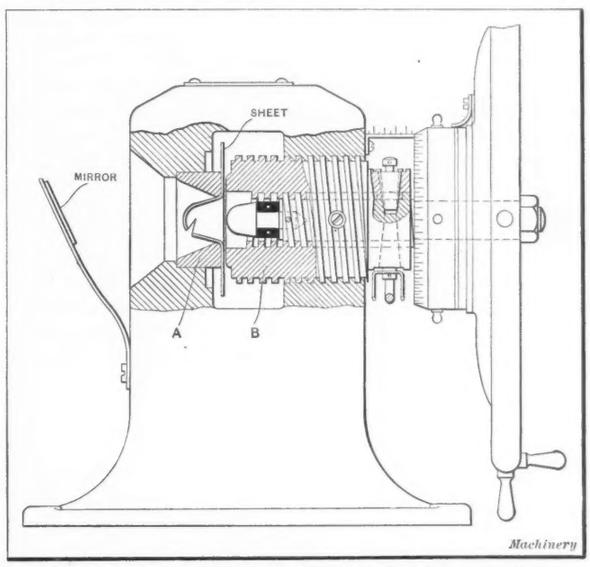
Protective coatings are sometimes used in an attempt to prolong the life of the crucible, such as a paint of finely pulverized carborundum fire sand mixed with water glass or boric acid. There is no doubt but that for certain purposes such coatings increase the crucible life. A protective coating of a nature somewhat similar to the foregoing is said to be largely used abroad and has recently been put on sale in this country. Reports from firms that are trying this are not based on long enough experience to be conclusive, but indicate that a saving may be effected in this way.

In a coal or coke furnace with proper fuel space for a given sized crucible, the use of either a larger or a smaller crucible decreases the crucible life; the life is also shorter in square furnaces than in round ones, owing, no doubt, to the less even heating. If the crucible is not allowed to cool down very far, but is kept hot continuously, so that there is less expansion and contraction, its life is lengthened. This is one reason for the longer life of crucibles in tilting than in pit furnaces. Continuous operation of brass furnaces for 24 hours a day is of course very rare. However, if the crucibles from a pit furnace, before they become cool, are promptly put back into the furnace after pouring, and if at night, after the last heat has been poured, the empty crucible is put back in the furnace and allowed to cool gradually with the furnace, the deterioration due to excessive expansion and contraction may be minimized.

## METHOD FOR TESTING SHEET STEEL

The accompanying illustration, reproduced from *Stahl und Eisen*, shows a device intended for testing sheet steel, or sheets of other metals, with a view to determining its properties for drawing and stamping purposes. The quality tested has been termed the "drawing value" of the metal. The principle of testing is as follows: The sheet is inserted between the die *A* and the holder *B*, the latter being so adjusted that there is a uniform amount of play between the holder and the die. The sheet is thus free to move under the influence of the advancing ram and can be pressed forward, as indicated, until a fracture is started. The depth of the depression is then measured and constitutes the drawing value. This depth depends largely upon the tenacity of the material. With homogeneous material, these drawing values are comparable and give a fairly accurate indication of the value of the material when used for drawing purposes. Considerable differences are found with different materials, however, and direct comparisons are not possible with metals of different kinds.

The test pieces should be about 3½ inches square and the amount of play about 0.002 inch. It is stated that besides the depth of the depression, the following characteristics of the




German Device for testing Sheet Steel for Drawing or Bending

test piece should be noted: If the break is round the material is homogeneous, but if the break is irregular or appears at some special point only, the material is fibrous and is not suitable for drawing or bending. In this latter case, the drawing value will also be found to be low. If the surface of the depression is smooth like the original sheet, the material is of good quality, but if it is rough or wrinkled, the material is not suitable for deep drawing, as the rough surface offers increased resistance, and a premature break with repeated drawings would be the result, even if the material would otherwise appear to be in good condition. A rough surface produced by the test is often found in sheet steel and indicates over-annealing. In copper and tin, the surface of the depression sometimes shows very fine small cracks, indicating that the material is not suitable for drawing.

The advantages claimed for the new device, which is protected by patent in Germany, are as follows: The test is simple and rapidly carried out; the test piece requires no preliminary preparation; the results are obtained by subjecting the metal to stresses similar to those produced by the actual drawing operation; the results of the test are clearly expressed and can be observed and measured by anybody with very little training; small differences in quality show themselves by relatively great variations in drawing value; and the appearance of the metal after testing permits definite conclusions to be drawn regarding the quality of the material and the degree to which it is adapted for the purpose for which it is intended.

# THE ANGLE OF TORSION

## DESIGNING SHAFTING OF COMPOUND GEARED MACHINES FOR EQUAL TORSIONAL STRENGTH

BY B. D. PINKNEY*

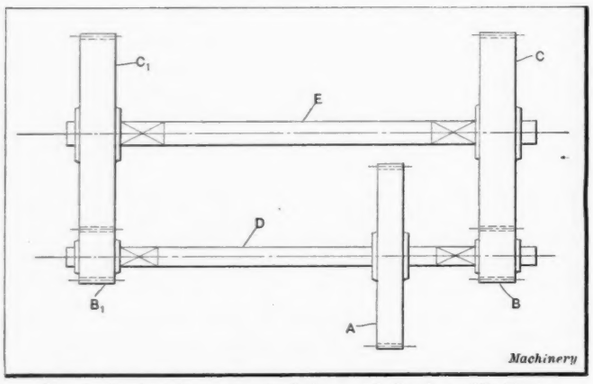



Fig. 1. Typical Arrangement of Compound Gearing with Power applied from within

CORRECTLY proportioning the shafts of double-geared or so-called compound-geared machines is often neglected, to the detriment of the driving pinions. It is my intention to show how the shafts of double-geared machines should be so designed that they are of equal torsional strength. The angles of torsion should usually be the same, but if that is unnecessary in point of stiffness, the driving pinion furthest from the point of application of the power should be advanced. This compensates for the difference of angular torsion, and permits equal loads to be transmitted by the pinions, resulting in an equal distribution of the wear. The two common forms of this type of drive are shown in Figs. 1 and 2, in each case the power being applied to gear *A*. With a uniform resisting load, there will be several times more torsional deflection in shaft *D*, Fig. 1, between gears *A* and $B_1$, than between gears *A* and *B*. These torsional stresses will be in proportion as $AB_1$ is to *AB* and the excess of torsion in $AB_1$ is called the "difference of the angular torsion." In shaft *D*, Fig. 2, the total torsion in $BB_1$ is the difference of the angular torsion, since the power is applied from without.

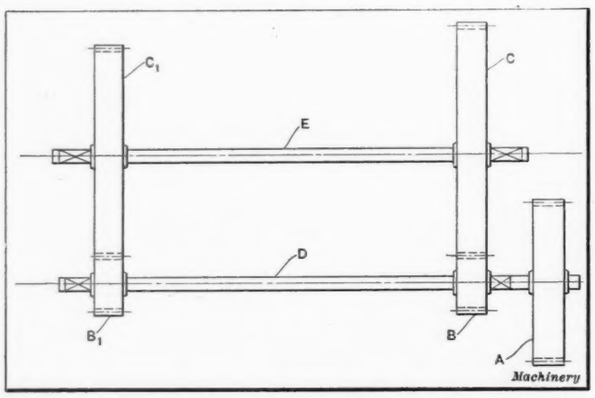



Fig. 2. Arrangement of Compound Gearing with Driving Gear on Outside

Experience has shown that the permissible angle of torsion of shafts varies according to the nature of the service, and is generally divided by machine designers [see Pencoyd, edition, 1900, page 239] into the three following classes: Class I shafts may have up to 0.05 degree per foot. These shafts are for very heavy service and, as such, are subjected to shocks or fluctuating loads and to reversal under full load. Class II shafts may have up to 0.075 degree per foot. These shafts are for regular service and, as such, will safely withstand shocks but must not be reversed under full load. Class III shafts may have up to 0.1 degree per foot. These shafts are for lighter service and not intended for fluctuating loads, unless the fluctuations are gradual; and they should not be reversed. This permissible angle of torsion is, of course, only applicable in proportioning shafts to resist torsion or, more strictly, for resisting torsion other than the predetermined torsion. Calculations for the angle of torsion are based upon the modulus of torsion of the material instead of the fiber stress, which is used in designing shafts to transmit loads irrespective of the effects of torsion, as long as the shaft is stiff enough to transmit the load. The table presented herewith gives the modulus of torsion for various materials commonly met with in machine design.

The principle of torsion is illustrated in Fig. 3 and the angle $\Delta$ is the angle of torsion referred to. The force *FR* is the statical torsional moment, or:

$$T = FR \qquad (1)$$

where $T$ = statical torsional moment;
$F$ = applied force in pounds;
$R$ = radius at which the applied force acts, in inches.

The length of the arc of the angle of torsion $a$ is found by the elementary Formula (2):

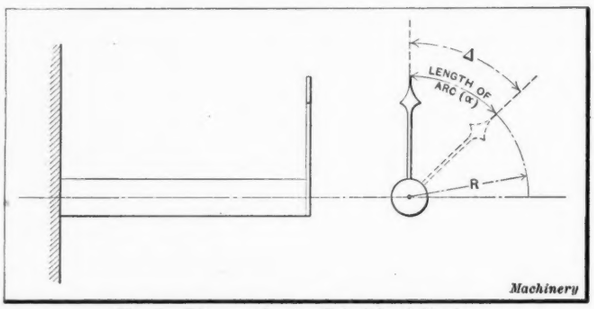



Fig. 3. Diagram showing Principle of Torsion

$$a = \frac{Tl}{JG} \qquad (2)$$

where $a$ = length of the arc of the angle of torsion, in inches (radius = 1 inch);
$T$ = statical torsional moment;
$l$ = length of shaft in inches;
$J$ = polar moment of inertia;
$G$ = modulus of torsion (taken from the table below.)

A complete table of polar moments of inertia is given on page 448 of MACHINERY'S Handbook, the polar moment of inertia of a solid round shaft being:

$$J = 0.098\,D^4 \qquad (3)$$

where $D$ = diameter of shaft in inches.

As it is more convenient to use the angle of torsion, Formula (2) may be expressed:

$$\Delta = 687.5\,\frac{TL}{JG} \qquad (4)$$

where $\Delta$ = angle of torsion for length of shaft subjected to torsion;

MODULUS OF TORSION FOR VARIOUS MATERIALS

| Material | Modulus of Torsion |
|---|---|
| Medium carbon steel (0.15 to 0.3 per cent carbon) also called machine steel | 10,500,000 |
| High carbon steel (0.3 to 2 per cent carbon) also called hammered steel | 11,500,000 |
| Cold-rolled steel (that has not been turned down from the original diameter) | 11,500,000 |
| Wrought iron | 10,500,000 |
| Bronze (average) | 5,000,000 |
| Phosphor-bronze | 5,500,000 |
| Maple (average) | 800,000 |
| Hickory (average) | 880,000 |

*Machinery*

* Address: 524 E. Third St., Newport, Ky.

$T$ = statical torsional moment; also (when the element of time is introduced) the torsional moment in inch-pounds;

$L$ = length of shaft in feet.

It frequently happens that the shaft $E$, Figs. 1 and 2, must be increased in diameter to withstand some great bending action, so that the angle of torsion as found by Formula (4) is much less for shaft $E$ than for shaft $D$. If shaft $D$ does not have to be reversed under full load, this defect is overcome by advancing pinion $B_1$ to coincide with the required difference of angular torsion. If, however, the shaft has to be reversed under full load, shaft $D$, Fig. 1, will have to be increased in diameter so that its angle of torsion is the same as that of shaft $E$; or shaft $D$ may be designed as shown in Fig. 4, to have equal amounts of angular torsion in parts $L_1$ and $L_2$, and thus relieve shaft $E$ from the effects of torsion. In the case of the gearing shown in Fig. 2, if shaft $E$ has to be increased in diameter to withstand a bending action, shaft $D$ must also be increased so that the difference of angular torsion is the same for both shafts, that is if the shafts are to be reversed under full load.

If it is required to find the angle of torsion of a shaft of different diameters as, for example, the cast-iron gage roll with steel journals, illustrated in Fig. 5, compute the angle of torsion for each length, $L_1$, $L_2$, etc., and the sum is the total angle of torsion.

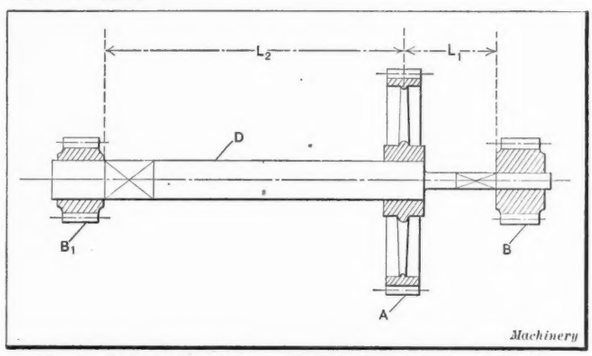



Fig. 4. Method of designing a Shaft for Equal Angles of Torsion

Introducing the element of time, we get from the elementary formula:

$$T = 63{,}025\,\frac{H}{N} \qquad (5)$$

where $H$ = horsepower;

$N$ = revolutions per minute.

Fig. 6 illustrates the driving pinions of a set of gearing similar to that shown in Fig. 1, which recently came to my notice. The outlines of pinions $A$ and $B$ were taken from the actual steel driving pinions which are for a double-geared gaging roll. The amount of wear, designated by the shaded portions of pinion $B$ (exaggerated about three times, for clearness), should have been corrected when the machine was designed. The engineer in charge informed me that this wear occurred soon after installation and no further wear had been detected for at least four months. The arrangement of the drive was as illustrated in Fig. 7, the driving pinions transmitting a total of five horsepower. The angle of torsion of that part of shaft $F$ designated $L_1$ is found from Formula (4) as follows:

$$\Delta = \frac{687.5 \times 900 \times 0.3333}{0.4185 \times 11{,}500{,}000} = 0.0428 \text{ degree.}$$

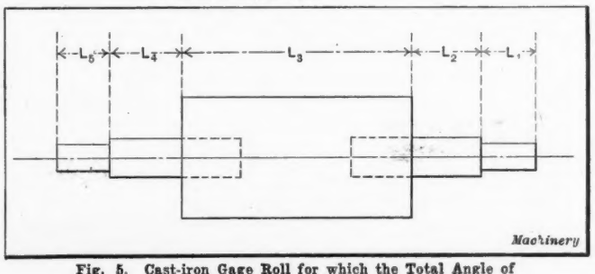



Fig. 5. Cast-iron Gage Roll for which the Total Angle of Torsion is required

The angle of torsion of that part of shaft $F$ designated $L_2$ is found from Formula (4) as follows:

$$\Delta = \frac{687.5 \times 900 \times 5.1667}{0.4185 \times 11{,}500{,}000} = 0.664 \text{ degree.}$$

The difference of the angles of torsion of parts $L_1$ and $L_2$ of shaft $F$ is:

$$0.664 - 0.0428 = 0.6212 \text{ degree.}$$

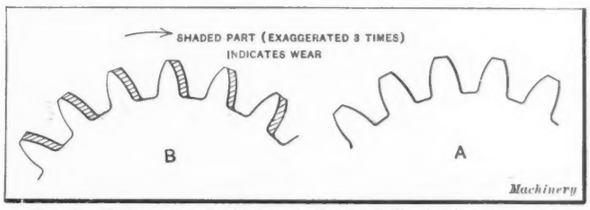



Fig. 6. Pinions of a Double-geared Gaging Roll, showing Wear due to Unequal Angles of Torsion in Shafting

For this variation, the key for pinion $A$ should have been advanced 0.6212 degree to have insured an equal load on the teeth of each pinion. In this case, it is well to relieve the gage roll shaft $G$ of all effects of torsion, and design shaft $F$ for equal torsion, as shown in Fig. 4, the part designated $L_2$ to have an angular torsion of 0.0428 degree instead of 0.664 degree. From Formula (4) we have:

$$0.0428 = \frac{687.5 \times 900 \times 5.1667}{11{,}500{,}000\,J}.$$

From the preceding equation, we find that 2⅞ inches is the required diameter. Expressing 0.6212 degree in circular measure as the circumference of the shaft, and bearing in mind that 360 degrees $= \pi D = 3.1416 \times 1\,7/16$ inch, we get:

$$0.6212 \text{ degree} = 0.0078 \text{ inch.}$$

This is the distance the key should have been advanced for the 1 7/16-inch diameter shaft. While this amount appears small, it is of vital importance, since the alternative is to make the part $L_2$ of this shaft just double the diameter or 2⅞ inches diameter. There are cases that have come to my notice where the key had to be advanced ⅛ inch in circular measure, to produce equal wear on the teeth of the driving

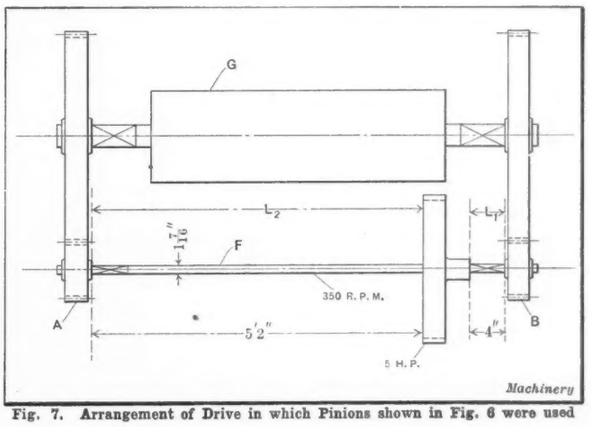



Fig. 7. Arrangement of Drive in which Pinions shown in Fig. 6 were used

pinions. There are numerous cases, also where the error is too small to compensate in the driving pinions, and which must be taken into account by increasing the diameter of the shaft so that no variation in the amount of angular torsion of the shafts exists.

* * *

## MACHINERY IN SWEDEN AND NORWAY

The total production of machinery in Sweden during 1912 is valued at $28,695,000. The imports of all classes of machinery into the country is valued at $5,175,000 and the imports of machine tools and small tools, at $800,000. The imports of machinery of all classes into Norway during the past year amounted to $7,500,000, and during the last six years the total imports of machinery into that country have amounted to $40,000,000. There are two hundred machine shops in Sweden employing twenty-five men each, or more. Of these, one employs 4000 men, one about 2000, five or six between 1000 and 1500, a dozen about 500, and upward of fifty shops 100 men or more.

# PACKING MACHINE TOOLS FOR FOREIGN SHIPMENT*

## CARDINAL POINTS TO BE OBSERVED AND POOR METHODS WHICH RESULT IN DAMAGED SHIPMENTS

BY J. A. FURER†

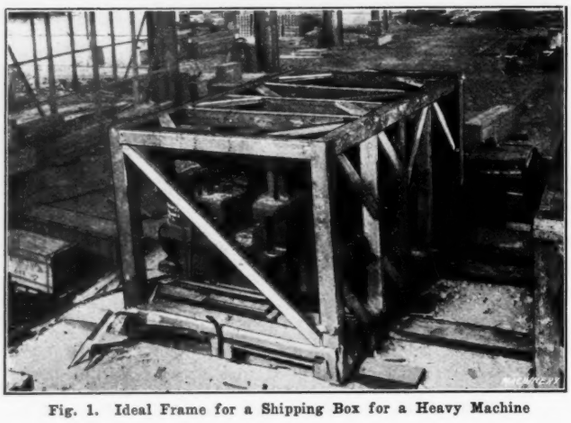


Fig. 1. Ideal Frame for a Shipping Box for a Heavy Machine

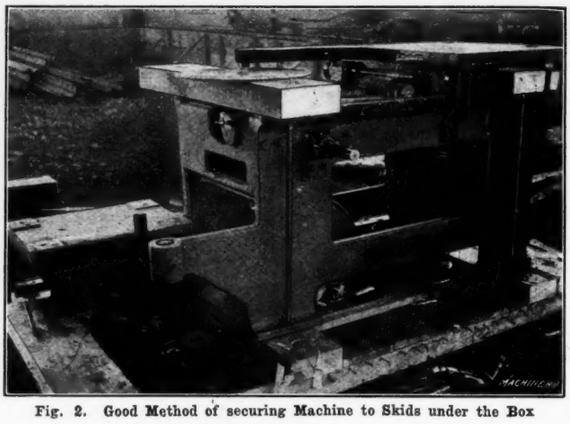


Fig. 2. Good Method of securing Machine to Skids under the Box

THE statement is frequently made, especially in comments on the export business of the United States, that American manufacturers do not exercise sufficient care in packing machines for over-seas shipment. It is quite possible that the export business of this country in machine tools has suffered somewhat, on account of frequent "bad order" deliveries. Consular and trade reports seem to bear this out as having been true, at least in the past. In recent years, however, much improvement seems to have been made in this respect. This criticism, even if exaggerated, is worthy of serious consideration by manufacturers, because a very large percentage of the bad-order deliveries in every ocean cargo can be avoided at little expense, by paying attention to correct packing.

The actual cost of making good transportation damage is usually the smallest item of the resulting inconvenience. Assume, for example, that a number of parts are found broken on a machine delivered inland in South America, which cannot be replaced locally. The purchaser must first of all go to the trouble of very carefully describing the broken parts, so that the manufacturer may make no mistake in supplying new parts. Generally it will be necessary to use the mails in order to insure proper description of the damage. If the plant where the machine was manufactured is located some distance from the coast in the United States, a rail transportation delay is first of all involved in shipping the replacement. Steamer connections must be made in the United States, and a further connection must be made to get the shipment by rail from the seaport in South America to the purchaser. Taking into consideration all of the normal delays, it is readily conceivable that the replacement of the damaged parts may take three or four months from the date of the delivery of the machine. All this time the purchaser loses the use of the machine, or at the very least his installation program is seriously interfered with. The inconvenience caused by these delays may be entirely out of proportion to the money value of the damage. The manufacturer, especially if the purchaser is in a position to lay the damage to poor packing, is naturally somewhat discredited by the occurrence in the eyes of the purchaser. The shipper usually blames the transportation company for all of the damage done in transit, as there is a fixed opinion in the minds of many people that freight handlers delight in dropping boxes from high altitudes, and that a gaping hole in the side of a case is very amusing to the stevedore. As a matter of fact, on many steamship lines, the officer who supervises stowing the cargo has to pay for the damage resulting from careless handling or due to improper stowing below. That officer, at least, may not find broken packages amusing.

The dock superintendent of a steamship company sums up the matter about as follows: "We have a right to expect that when a shipment is billed as machinery and is being carried at the machinery rate, it should be safe to pick up the boxes by means of slings without danger of crushing in the sides or having the contents drop out through the bottom. We feel, also, that swinging a box over the side of the ship at a slight angle from the horizontal, should not result in a $2000 lathe breaking its way through the end of the box and falling into the hold below, on top of innocent cargo. We also hope that the shipper knows that winds still blow and ships still roll. The only way to circumvent the evil effects of rolling on the contents of boxes, is to have everything tight and snug inside; all that we can do to prevent damage from rolling is to stow the cargo so that the boxes themselves cannot shift." The most ardent defender of the stevedore cannot claim that the business of

* For other articles on the subject of packing machinery for shipment published in MACHINERY, see also "Packing Machine Tools for Export," February, 1909, and "Packing Machinery for Export," July, 1909.

† Naval Constructor, U. S. Naval Station, Pearl Harbor, Hawaii.

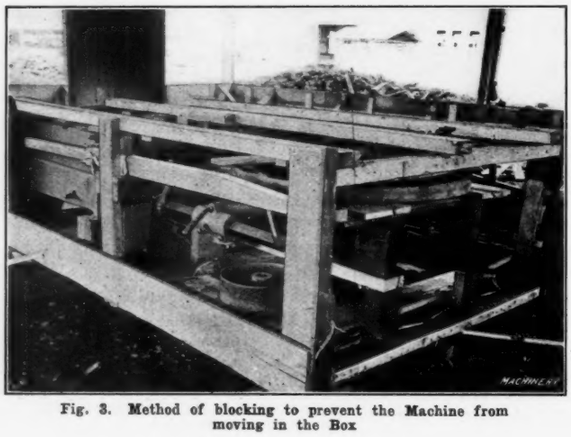


Fig. 3. Method of blocking to prevent the Machine from moving in the Box

Fig. 4. Good Practice in packing Small Parts. Tar Paper is used to exclude Moisture

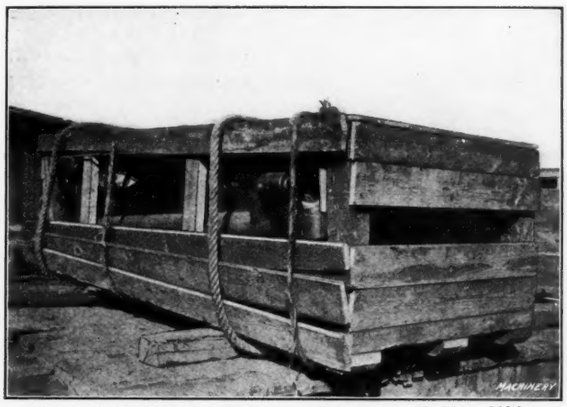


Fig. 5. A Packing Box that was racked by the Machine shifting

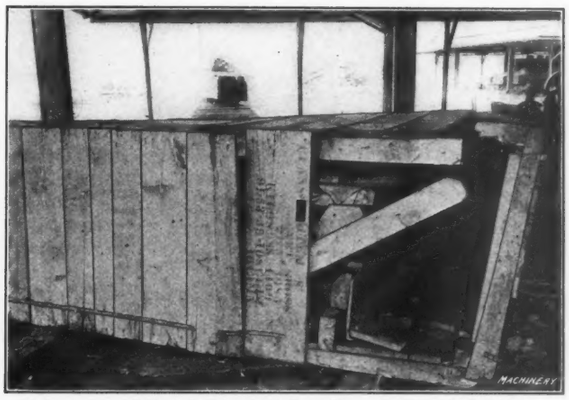


Fig. 6. Insufficient Bracing and Poor Strapping caused Breakage

stowing a ship's cargo is the gentlest profession in the world. No doubt the transportation companies are often at fault, but the chances of damage to machines are always minimized by good packing.

The United States Government recently purchased $500,000 worth of machines for the shops at the new naval station, Pearl Harbor, Hawaii. The contracts covered every class of tool used in the machinists', wood-working, ship-fitter's, foundry, blacksmithing, pipe-fitter's and allied trades. Practically all of the machines were manufactured in the United States. At least 90 per cent of the shipments went through New York and thence to their destination, *via* the Isthmus of Tehuantepec. As the amount of handling which a package receives is the governing factor in its liability to damage, these shipments may be said to have been subjected to an unusually large damage risk. In the first place, the machines had to be shipped by rail from the manufacturer's plant to Jersey City, or to one of the other New York Harbor railroad terminals. From this point they were lightered to the docks of the steamship company in Brooklyn. From there they were carried by steamer to Puerto Mexico, unloaded, transported by rail to Salina Cruz, reloaded on steamers and carried to Honolulu, unloaded on the docks and finally shipped by rail to the naval station at Pearl Harbor. More than 300 machines or groups of equipment were covered by the contracts, consisting in all of many thousands of packages. The equipment for one of the 300 groups alone, was composed of over 800 individual packages. Taking into consideration the length of the route from the manufacturer's works to Pearl Harbor, the number of transfers involved and the large number of packages in the shipments, remarkably few machines were found damaged on arrival. But even at that, the damage to some of the shipments might have been avoided by good packing, although the transportation companies unquestionably contributed their share of the breakage in handling.

The requirements for packing machines for foreign shipment so as to reduce the chances of damage to a minimum may be briefly summarized as follows:

1. A crate is less than no protection to a machine, because the freight handler is always tempted to hook onto a slat in order to lift the package. Furthermore, a crate is bound to rack if the contents are heavy. Then again, all foreign shipments run the risk of being exposed to water damage; and if so exposed, a crate offers no protection. There are a few classes of goods which go more safely if crated, such as fire brick, because the stevedore can see that the contents are fragile and must be handled with unusual care, but this does not apply to machines. A substantial box is therefore the first requisite to safe packing.

2. The box should always be built on skids. Skids serve a number of purposes. They invite attention at once to the side on which the box should be landed; they distribute the load uniformly on the whole structure of the box; and they provide a continuous and heavy foundation to which crosspieces can be bolted for carrying the machine. Skids are to the box what sills are to a house.

3. If the box is at all bulky and the machine is heavy, corner posts, studding and cross bracing should be fitted so as to prevent all possibility of racking.

4. The machine should be bolted (not secured by lag screws) to the cross timbers fitted on top of the skids. In addition, the machine should be braced and chocked to the sides, ends and top of the box, so that no matter which way the box is landed the machine cannot shift and break through it.

5. Nothing should be placed in the box loosely. If small parts form a part of the shipment, for which there is room inside of the large box, they should be separately packed and the small box secured inside, or the parts should be individually secured inside of the large box.

6. The box should be lined with tar paper or other water-excluding material.

7. The boarding should be sufficiently heavy to reduce the chances of local damage to a minimum. In spite of every precaution, boxes are occasionally dropped on top of other packages in handling. If the planking of the box underneath is heavy, the contents stand some chance of escaping without damage.

8. Strap iron of generous width and thickness should be

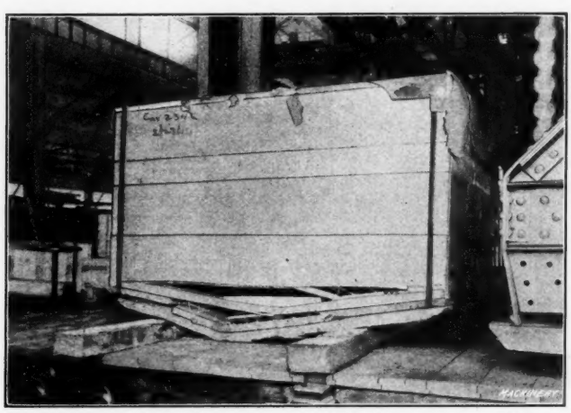


Fig. 7. Box broken from the Use of Skids that were too Light

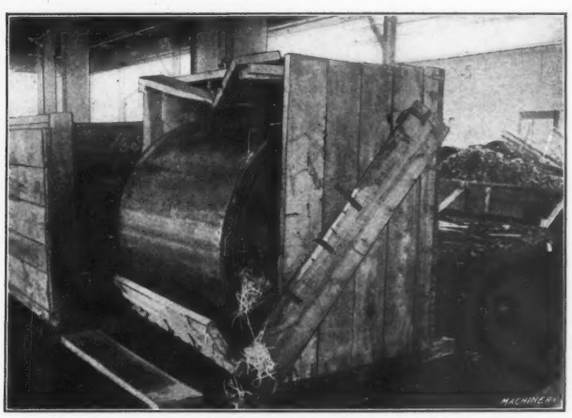


Fig. 8. Damage caused by packing Fittings loosely in the Box

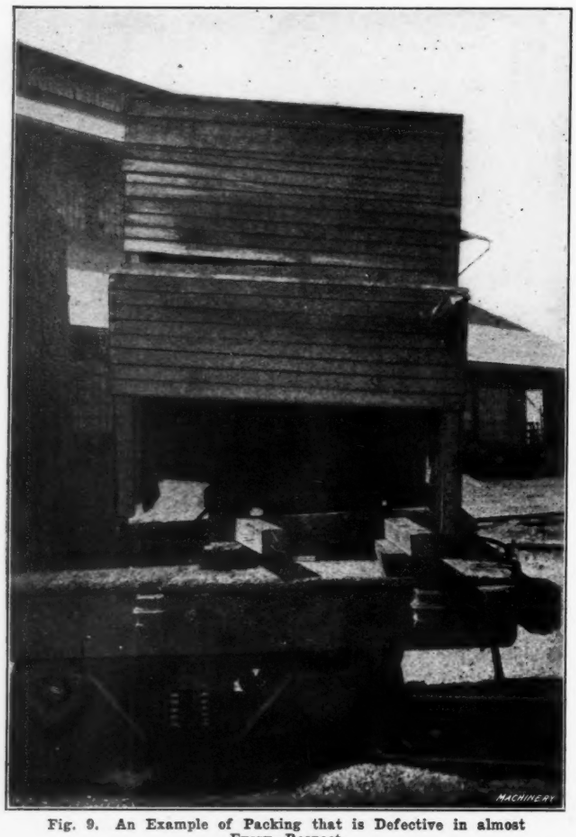


Fig. 9. An Example of Packing that is Defective in almost Every Respect

fitted around the box in both directions, both lengthwise and crosswise. The strapping should go all the way around the box and should not be fitted merely to the corners, as is sometimes done. The cost of adequate strapping is a small item, but adds very considerably to the strength of the box.

9. Adequate protection of machined surfaces against corrosion, while in transit, should not be neglected. The practice of shippers differs widely in this respect. Some manufacturers give machined surfaces merely a coating of heavy oil. This is altogether inadequate for a shipment that is going to be in transit several months. A very thick coating of petrolatum usually affords sufficient protection. White lead and tallow is still better, but is difficult to remove. A number of slushing compounds are on the market, which form a coating similar to a layer of paint; they can be removed readily by means of kerosene and are in this respect superior to white lead and tallow. Some of these compounds are, however, worthless, as they become brittle and flake off in a few weeks.

The accompanying illustrations show examples of both good and poor packing. Fig. 1 shows the framing of a box for a heavy machine with the planking removed. The gross weight of the machine was 34,300 pounds. The box was 11 feet 8 inches long by 7 feet 5 inches wide by 6 feet 9 inches high. It will be noted that there are three 6 by 8½-inch skids provided, and that 3 by 6-inch cross sills are bolted on top of the skids. The machine is bolted to these cross sills. The main framing consists of 6 by 6-inch timbers. The box was, in addition, securely strapped by 2-inch band iron 1/16 inch thick. The planking was 1½ inch thick. In general, this box was ideally constructed. The shipper failed, however, to line the box with heavy paper, and consequently the machine was found considerably rusted because spray or rain water had evidently found its way through the cracks of the planking. The shipper also placed a large number of parts, such as wrenches, fittings, etc., loosely inside of the box. If the box had been turned over in transit these loose parts would have done considerable damage to lubricating pipes, oil cups and other more or less delicate fittings. Attention to these two neglected rules of good packing would not have increased the cost of preparing the machine for shipment very much, and would have insured its perfect condition on arrival.

Fig. 2 shows a good method of securing a machine to the skids so as to prevent movement. This machine is comparatively light, the gross weight of the package being only 2000 pounds. It will be noted that timbers have been fitted across the top of the machine, and that long bolts clamp the upper to the lower timbers. Any possible movement of the machine in the box was in this manner forestalled. The box was braced diagonally so as to prevent racking.

Fig. 3 shows how similar results can be obtained by proper blocking where the machine is not so compact as the one shown in Fig. 2. This machine is also comparatively light, weighing only 3500 pounds. The left-hand portion of Fig. 4 shows a box containing two starting panels for motors. It will be noted that a double box has been used for packing these panels. Tar paper was fitted inside the inner box so as to keep out moisture. Better results would probably have been obtained if the tar paper had been fitted between the two boxes. All movable parts inside of the panels are chocked and braced. The right-hand box in this illustration shows small parts excellently packed.

Illustrations are also presented of some of the machines which were received in damaged condition. In all cases, defects in packing will be noted. Of course, the statement cannot be made that negligence in packing was entirely responsible for the condition in which these machines arrived, but it is more than a coincidence when shipments are generally found damaged, in the preparation of which all the rules of good packing have not been observed; whereas those which have been correctly packed are seldom found damaged. These illustrations are not published in a spirit of criticism, but because they may be of value to shippers at large in correcting their packing methods. It is always difficult to visualize the hazards to which shipments are subjected in transit. It is particularly difficult for the manufacturer to comprehend just wherein his shipping department fell short, when he receives a report of damage, because he very seldom has an opportunity of seeing an over-seas shipment when it arrives at its destination.

Fig. 9 shows a machine weighing 4700 pounds, packed in a

Fig. 10. Box broken through Failure to secure the Machine to Skids and due to Insufficient Strap Iron

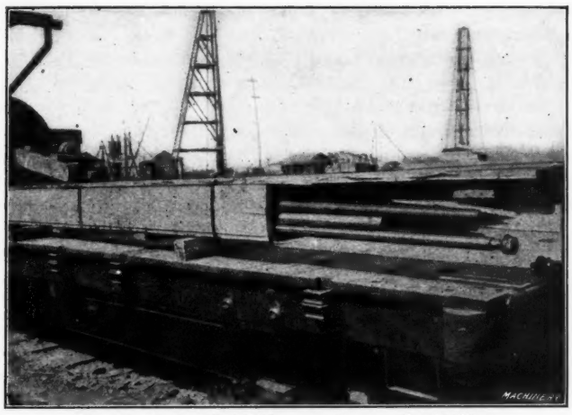


Fig. 11. A Box that broke open because the Shafting was not chocked

box 6 feet 6 inches long by 7 feet 1 inch high by 5 feet 2 inches wide. The box was not built on skids and was not strapped with band iron. Consequently, the machine dropped through the bottom. The outside of the box was made of ⅞-inch tongue and groove boards, which were entirely too light for this purpose, especially because the box was not rigidly framed. The box was not lined with tar paper, and as a consequence the machine was found badly rusted. The gross weight of the machine shown in Fig. 5 is 6000 pounds. The box was 8 feet 10 inches long by 44 inches wide by 33 inches high. In preparing this shipment some of the rules of good packing were observed, but others were neglected. Adequate skids were provided, but the main frame of the tool was not bolted to the skids. The corner posts were sufficiently heavy, but the boards, consisting of ⅞-inch tongue and groove stuff, were only lightly nailed thereto. Furthermore, no strap iron was used to reinforce the sides. A number of parts were also placed loosely in the box; consequently the contents shifted, which resulted in loosening the boards, as will be noted from the illustration. Enough money was undoubtedly spent on this box to have made a good job, but inattention to such comparatively small details as proper nailing, bolting the base to the skids, and fitting strap iron, resulted in the machine being delivered in bad order.

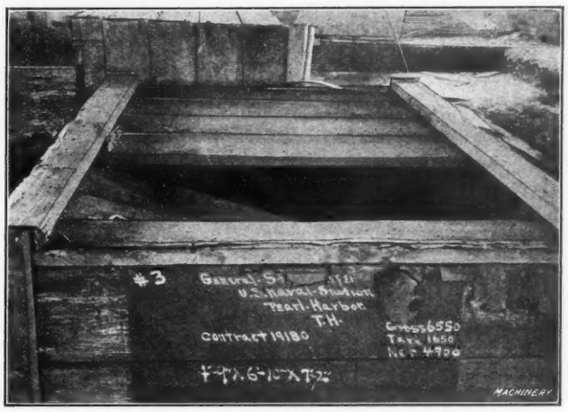



Fig. 12. Damage done by dropping a Heavy Article on Top of the Packing Box

The machine shown in Fig. 10 weighed 9365 pounds. The main frame was not bolted to the skids and no chocks were provided to prevent movement of the contents of the box; consequently the machine punched its way through one end. Also, the box was strapped in only one direction. If strap iron had been carried around the box in both directions the end planking might have held, as the boards were 1¼ inch thick. The gross weight of the machine shown in Fig. 6 was only 3080 pounds, but due to insufficient bracing and lack of adequate strapping, the machine shifted and broke through the end of the box. The ¾-inch strap iron was carried beyond the corners only about 6 inches. If it had been carried entirely around the box, and if it had been somewhat heavier, it is likely that no damage would have resulted in transit, as the framing of the box was otherwise adequate. Fig. 7 illustrates a good example of the consequences resulting from the use of light skids. The gross weight of the machine was 5150 pounds; and the size of the box was 6 feet 2 inches by 3 feet 7 inches by 3 feet 7 inches. The dimensions of the skids should have been given special consideration because all the weight in the case of this machine is concentrated practically at the middle. The skids were only two in number and consisted of 2 by 6-inch scantlings. An additional band of strap iron around the middle of the box might possibly have compensated for the weakness of the skids.

Fig. 8 shows an excellent example of the damage which can result from packing fittings loosely. The gross weight of the box was 6000 pounds; and the size, 60 inches by 66 inches by 53 inches. Inside of the circular plates were packed a large number of heavy castings. An attempt was made to wedge these castings by means of straw, which matted up and soon permitted free movement. It will be noted that the strap irons are only corner pieces, consisting of 1-inch bands extending about 3 inches beyond the corner. Each strap was held by only two nails. If the strap iron had extended entirely around the box, and if the castings had been chocked inside so as to prevent movement, there could have been no damage, as the box was strongly built of 2-inch boards. The box shown in Fig. 11 broke open because the shafting was not chocked, thus permitting endwise movement. The box was furthermore weak at the butt joint of the planking. The boards should have been in one piece the full length of the box. This was quite practicable, as the box was only 19 feet long. In any event the butt joints of adjacent boards should have been staggered. One of the pieces of shafting was lost from this box.

Fig. 12 shows the kind of damage which is not serious if the shipper has taken the precaution of building a good box around the machine. A heavy package was apparently dropped on top of this box, which resulted in breaking through two of the planks. The box was, however, so well built that no further damage was done, and the machine arrived in good condition. The box was made of 1⅝-inch boards, built on heavy skids, well framed and sufficiently strapped. A lightly built box would, no doubt, have been badly crushed by anything heavy enough to break the planks as shown. The weight of the package shown in Fig. 13 was 3000 pounds. The box was 98 inches long by 44 inches wide by 33 inches high. It was well constructed, in general; but the machine was not properly secured inside, permitting end movement which resulted in breaking the box. The strap iron was also very light. Heavy strap iron carried around the box in both directions might have saved the shipment from damage.

* * *

The total value of the machinery imports to Japan during 1913 amounted to $17,119,000, of which 25 per cent came from Germany and about 21 per cent from the United States.

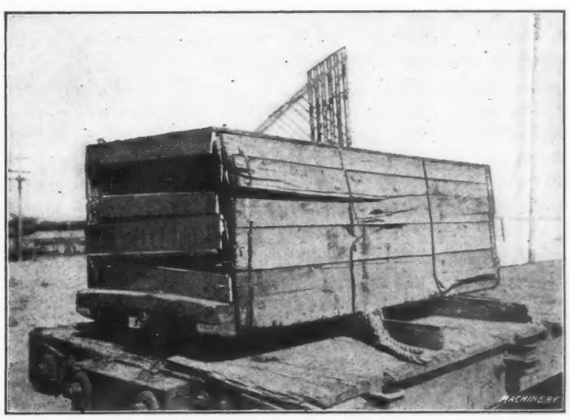


Fig. 13. This Box was damaged due to the Use of very Light Strap Iron and Failure to bolt the Machine to the Skids

## INSTALLATION OF A GAS ENGINE*

There are a number of points that should be considered before purchasing a gas engine, one of which is the amount of power required for the work to be done. It is generally advisable, no matter what style of engine is to be purchased, to buy a unit somewhat larger than may at first seem necessary. It is always well to have some power in reserve, because an engine working under an excessive load is inefficient and involves a money loss to the owner on account of the wear and tear on the engine.

The style of engine to be used is determined by the location and the nature of the work to be performed. If the engine is used in a fixed location a stationary type should be selected, whereas the portable type and the traction engine must be selected when the engine is for use at various points and when loads are to be hauled. The selection of the right type is fully as important as the selection of the right make; also, while attractive paint and a high polish are desirable, these tell very little of the real value of the engine.

When repairs are necessary, the importance of having an engine which has been standardized is fully realized by the purchaser. Repair parts should be obtainable at convenient points within a few hours, because delays in waiting for repair parts usually prove expensive.

It is important to bear in mind that the rated horsepower of an engine is not always a reliable basis for comparison with the actual power that the engine will deliver. There are many gas engines on the market rated at five horsepower, for example, that will hardly have a maximum output of as much as five horsepower under regular operating conditions. Again, there are engines built by reputable manufacturers that deliver continually an overload of as much as 20 per cent above their rating. If there is any doubt in the mind of the purchaser as to the power that it is possible to obtain from an engine, he should insist upon proofs of the actual brake horsepower.

When the engine has been purchased, the next thing to consider is where it is to be placed. In selecting the position for the engine, note that it ought to be placed in the cleanest, driest and lightest spot obtainable. If it is to be belted to machinery that is already in place, it is necessary to decide where the flywheel will be located, and the foundation should be made with this in mind. If the machinery is to be installed later, suitable position for it must be determined at the time the engine is installed in order to insure that no difficulties will be met with in transmitting the power. If the engine is installed in a large room, a small room or space should be partitioned off around it in order to keep out dust and dirt. Under all circumstances, never allow a gas engine, or any other engine for that matter, to run in the same room with emery or polishing wheels.

Assuming the engine to be of the stationary type, the purchaser should obtain a templet and anchor bolts, generally furnished with each engine. The templet is a wooden frame of the size of the bottom of the base of the engine, having holes in it to match the holes in the base of the engine frame.

### The Foundation

The dimensions of the foundation at the bottom should be at least twice the length of the engine base and not less than two and one-half times the width, and the depth of the foundation should be equal to its length. The shape of the foundation is then made in the form of a frustum of a pyramid, sloping up toward the top, where it is only about three inches larger on all sides than the base of the engine. When the hole has been dug in the ground, a form for the concrete must be made and then the concrete is mixed as follows: one sack of good cement, two wheelbarrows of sand, and three wheelbarrows of crushed rock or small gravel, well mixed with water to make it easy to handle. When putting the concrete into the form it is advisable to use old scrap iron of all kinds, chains, wire, etc., to reinforce the concrete and keep it from cracking. Put in the concrete and scrap iron together, tamping it tightly into the form. Before putting in the concrete, however, place the anchor bolts in the bottom of the hole, with large heavy washers on their heads, and use the templet to locate them properly at the bottom; then run the nuts down on the anchor bolts far enough to allow the templet to rest upon them while locating the bolts at the top at about the level where the engine will be set on the foundation. Then fasten the bolts in some way so that they will not move while the concrete is being put in place. The wooden templet is left on the top of the foundation, the nuts, of course, being removed when the foundation reaches them, and the engine is set on the top of the templet, as it is advisable to use a thin strip of wood between the concrete and the cast iron of the base. The foundation should be left to set at least four days before the engine is placed on it.

### Removing an Engine from a Railroad Car

The foundation now being ready, we will assume that the engine has arrived in a railroad car at the station, and that it is to be removed from there by the purchaser. A few points relating to this operation will prove of value. The engine has been delivered to the transportation company by the manufacturer or dealer, properly packed for shipment. The responsibility of the manufacturer or agent stops at this point, and the transportation company is supposed to deliver it to the purchaser in perfect condition. The engine, if of a heavy type, has been transported in a separate car, and is left on a side track accessible for teams. The first thing to do is to have the local station agent make an inspection of the engine in the presence of the purchaser or his representative, to see if it is in good condition and that no damage has been done to it in transportation. Should any damage be revealed at this inspection, the station agent should be required to make a notation of the damage upon the expense bill before the freight is paid. After this is done, the transportation company is liable for the damage, if any, and the buyer is safe in unloading and taking charge of the engine.

If any timbers or assistance is needed in unloading the engine from the car, the transportation company, through its agent, is supposed to furnish them. If the transportation company furnishes bad timbers for this purpose and an accident is caused thereby, the mere acceptance by the purchaser of the bad timbers does not place the responsibility upon him. The engine should preferably be moved onto a flat top dray wagon without springs. In moving the engine, take care to see that it is properly supported at all times, and see where each step in the moving is going to leave it. If any accident happens to the engine before it is clear of the car or before it is taken off the skids conveying it from the car to the wagon, the transportation company is liable for the damage, because being a local shipment, the company is supposed to remove it from the car and the purchaser is merely acting for the company when taking the engine from the car. After the engine is placed on the wagon, the purchaser is entirely responsible for it.

As an example of what may be encountered in unloading an engine, the following experience may be mentioned. An engine arrived at its destination in good condition and the car was set on a siding near a pile of ties that were to be used in unloading. Some other timbers were also necessary which the agent of the railroad company furnished, but these were not as strong as the man unloading the engine required; however, the station agent informed him that he would have to use them. He went on with the operations, taking extra precautions to brace the weak timbers, but just as the engine was about half way between the car and the wagon, one of them gave way and the engine went into a ditch upside down. The man in charge of the unloading went to the long-distance telephone and called up the general agent of the manufacturing company, stating the circumstances and asking for instructions. He was told to inform the station agent that the engine could not be used, and that it would be left on the railroad company's hands. A new engine was loaded at the factory the same day and shipped, and in that case ample assistance ws rendered in unloading the new engine. The first engine was loaded by the railroad company onto a car and returned to the factory free of charge; the bill for the necessary repairs was rendered to the railroad company, and was paid without a damage suit.

* This article is prepared mainly from a series of notes by J. L. Hobbs, gas engine expert.

After the engine is safely placed on the wagon it should be conveyed by the safest and easiest road to the place of installation. Avoid uneven ground and bad street crossings; take plenty of time and be sure of every move. Always release the team from the wagon while loading and unloading the engine. The unloading is greatly simplified if two trenches are dug for the wheels of the wagon so that the axles almost touch the ground. In this case, the timbers on which the engine is handled will be more nearly level. If they are entirely level, rollers may be used under the skids to which the engine is fastened. If, however, the timbers slope at all, rollers should not be used. The main thing is to avoid haste, and not to permit anything to interfere until the engine has been placed on the foundation.

### Installation of Auxiliaries

The next thing is to select a suitable place for the battery box. This place should be dry and free from vibration. The wiring is now connected. If natural gas is to be used as a fuel, it is necessary to have a special mixer, which will be furnished by the manufacturer of the engine. All that is necessary is a gas bag or tank and piping to allow the charge to be drawn quickly into the cylinder. Some engines use gasoline for a start and then switch onto the natural gas, while others start directly on the gas. If the engine *will* start on the gas, there is no good reason for using gasoline.

If liquid fuel is to be used, it is advisable to place the fuel tank outside the building and it is still better to bury it in the ground. After the tank has been buried in a suitable place, it is an easy matter to arrange the piping to the fuel pump on the engine. As far as possible, this piping should be underground, as it is out of the way. A pipe for the fuel, passing from the pump to the mixer, and a pipe for the overflow to return from the mixer bowl to the tank, must be provided. If the overflow pipe stops at the top of the fuel tank, it will not be necessary to have a vent hole at the top of the tank, as the air will flow into the tank from the overhead pipe which will not always be full of gasoline. The pump pipe should pass to the bottom of the tank and should be provided with a light screen to prevent foreign substances from passing into the mixer.

### Starting a New Engine

After the engine is properly installed, the first thing is to start it running. This is done by turning on the battery switch, setting the needle valve in the starting position, turning off the air damper, releasing the compression, and giving the flywheel a few turns, which will put it in motion. After the engine has made a few revolutions, open the air damper, close the needle valve to the running position, put the relief cam back into place, and let the engine run, watching for developments. It is, of course, presumed that all the oilers and grease cups have been filled, and that all movable parts have been oiled with the oil-can. Now see that water enters the cylinder cooling jacket within five minutes, or stop the engine, as it is not safe to allow it to run without cooling water on the jacket. It is best to allow the engine to run an hour or so without any load, and to watch the bearings to see that they do not become overheated. In case of doubt on any point, stop the engine and examine it.

In cold weather, a gasoline engine is more difficult to start than in warm weather, the reason being that gasoline, in changing from a liquid to a vapor, reduces its temperature about 30 degrees F. If the air is cold on the outside of the cylinder and the mixer has taken in vapor 30 degrees colder, it is easy to understand that this would interfere with the proper vaporization. Hence, it will be difficult to start the engine. There are several methods of overcoming this difficulty, either by warming the gasoline, warming the air, or by using one part ether and four parts gasoline for a start; this will make a liquid that will vaporize readily several degrees below zero. To warm the gasoline is a process which is dangerous and should only be attempted as a last resort. It can be done safely only by using hot water or a hot cloth. The air may be warmed by heating a piece of iron red-hot and holding it at the mouth of the intake pipe, allowing the air to pass over it as it goes into the intake pipe, after which it joins the gasoline vapor and heats it.

## HYDRAULIC BROACHING

Up to within a few years ago, broaching was looked upon as a "fussy" operation, always to be avoided if possible, but of late it has been so highly developed that it is now on a par with other machining operations. When we speak of broaching, we usually think of horizontal broaching, as that is what has been most commonly done, but another kind of broaching which is coming more and more in evidence is vertical broaching in hydraulic presses.

The Watson-Stillman Co., of Aldene, N. J., has made many presses for hydraulic broaching and uses several in its own shops for broaching operations on manufacturing work. These machines are all of the vertical type and they have been found to be easier to handle with certain classes of work than the horizontal type. One of these presses is shown in Fig. 1. Again, in Fig. 2 is shown a closer view of the press, that illustrates the facility with which the work may be handled. In the horizontal type of broaching machine the

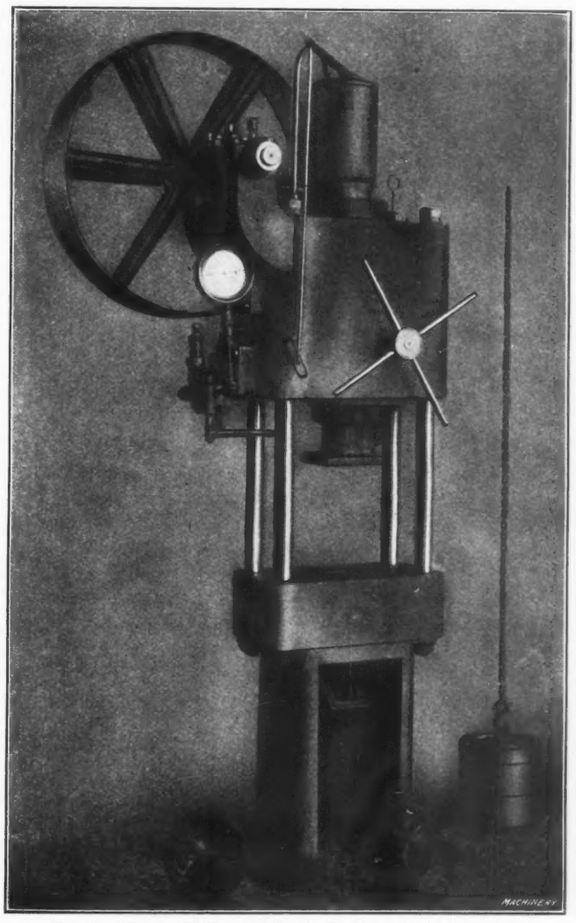


Fig. 1. Watson-Stillman Hydraulic Press used for Broaching

force required to drive the broach is applied through a driving screw, but with a hydraulic press it is applied through a ram driven by a pump.

Another advantage claimed for hydraulic broaching is that short broaches may be used—from one-fourth to one-sixth of the length of broaches for horizontal use. On this account, there is much less danger of breakage in hardening or in use, as the steel is under compression while in use, rather than under tension. When the work will permit it, the broaches are driven clear through the hole and dropped out on the under side. In Fig. 3 there appears a set of four broaches for finishing a hole for a square shaft. The economy of using short broaches is also apparent when it is stated that when the full-sized broach wears small it may be ground down to the next smaller size, and so on until the size of the last broach in the set is reached. Therefore it is only necessary to replace one broach each time the entire set is normally worn out.

An idea of the amount of metal removed in broaching with vertical or "push" broaches, as they are sometimes called, may be obtained from the table of sizes given for the four broaches, *A*, *B*, *C* and *D* shown in Fig. 3.

| | Broach A | Broach B | Broach C | Broach D |
|---|---|---|---|---|
| Start | 1.075 | 1.100 | 1.125 | 1.145 |
| Finish | 1.105 | 1.130 | 1.155 | 1.156 |

From these figures it will be seen that each of the broaches removes practically 0.030 inch of metal except the last broach, which only has 0.001 inch to take off to finish the work, and is therefore more in the nature of a smoothing broach.

An interesting hydraulic broaching operation is the one illustrated in Fig. 2. This shows the planish-broaching of a hole that has been previously drilled and reamed in the casting shown on the bed of the machine. The broach removes no metal, but planishes the stock on the surface of the hole, leaving it to size; and, moreover, because the metal is compressed, the finish is much better and the wearing surface much harder.

The broach for this operation is shown at *E* in Fig. 3, and in Fig. 4 the details of the broaching end are seen. The

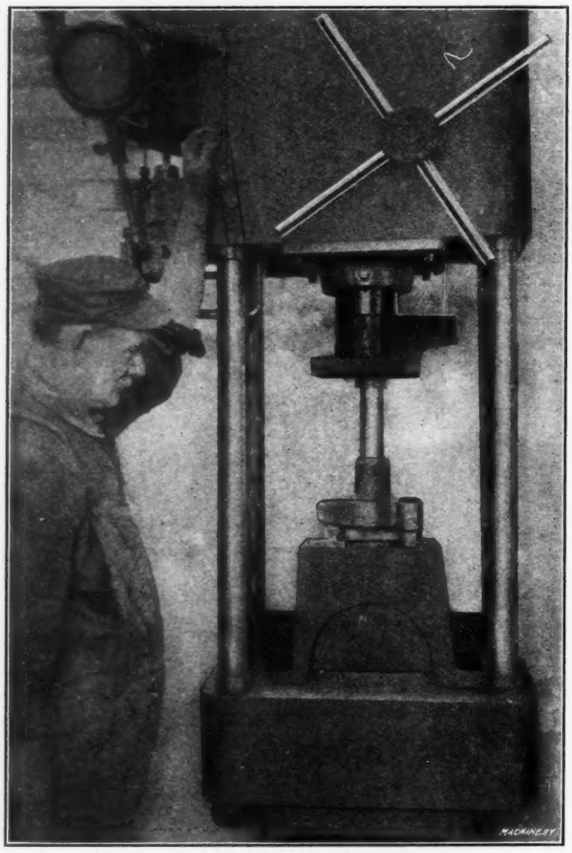


Fig. 2. Planish-broaching in a Hydraulic Press

broach has four different sizes as shown. The reamed hole is 0.003 inch under size and the entering part of the broach is made just to size. The corners, however, are well rounded so that the broach will start without difficulty. The first raised rib on the broach end is made 0.002 inch over size. The next rib is left 0.003 inch over size, and the body of the broach is made 0.001 inch under size. The object of this broach is to planish the metal out to a size enough larger than the finished size to allow for the "spring-back" of the metal. The amount of "spring-back" depends, of course, upon the thickness of the wall and the character of the metal.

In hydraulic broaching the amount of pressure that is being applied to the broach at all times is shown by the hydraulic gage. This is important as it tells the exact time at which an overload is being put on the broach and, the safety point of the broach being noted, it is easy to keep on the safe side. Any range of speed may be secured in hydraulic broaching, and this speed is only limited by the capacity of the broaching tool for doing the work. Less floor space is

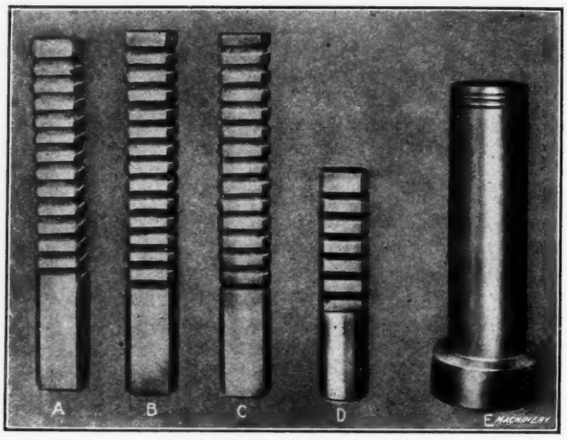



Fig. 3. A Set of Push-broaches

required for hydraulic broaching machines than for the horizontal type of broaching machine. The horizontal broaching machine is a single-purpose machine tool, in that it can only be used for broaching, but the hydraulic press, in addition to being used for broaching, may be used for forcing on arbors, forcing gears on and off shafts, straightening, and for various other machine shop jobs requiring pressure.

* * *

## INTERESTING TELEPHONE STATISTICS

According to recent statistics, there are 9,200,000 telephones in the United States and Canada, and 3,700,000 in Europe. On an average, this means one telephone for each eleven inhabitants in the United States, while there is only one telephone for each 125 inhabitants in Europe. With regard to the distribution of the telephones in cities and in the country, we find that in cities of more than 100,000 inhabitants there is, in the United States, one telephone to every nine persons, whereas, in the country districts, there is one telephone to every thirteen persons. In Europe the difference in the number of inhabitants per telephone is very marked dinavian countries. Thus, we find that in the three Scandinavian countries, Sweden, Norway and Denmark, there is one telephone to every twenty-five inhabitants, while in Germany there is only one telephone to every fifty-two inhabitants, in England one to every sixty-two inhabitants, and in France one to every 140 inhabitants. Of all the cities in the world, Stockholm leads with the number of telephones per capita, there being at the present time one telephone for every 4.4 inhabitants. Another interesting comparison is made between the number of telephone conversations and the number of letters transmitted by mail. In the United States, there are sixty-one telephone conversations to every thirty-nine letters. In Germany, there are thirty telephone conversations to seventy letters; in England there are twenty-three to seventy-seven letters; while in the Scandinavian countries there are sixty-six telephone conversations to thirty-four letters.

* * *

The total exports of belting from Germany in 1912 were valued at $3,675,000, of which over $1,000,000 worth was exported to Russia.

* * *

Universal formula for the prevention of warfare: Never start a fight with a customer.

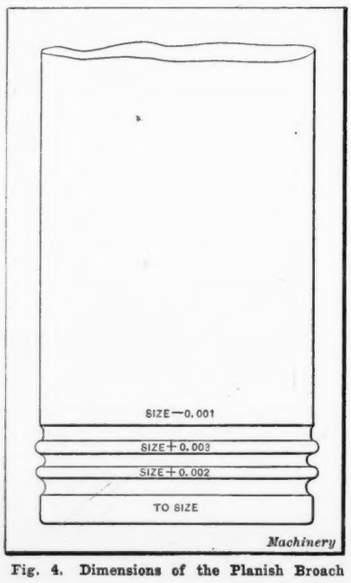



Fig. 4. Dimensions of the Planish Broach

# PROVIDING FOR UP-KEEP IN THE DESIGN OF CUTTING TOOLS

EXAMPLES OF TOOLS AND DEVICES THAT HAVE PROVED EFFICIENT IN PRODUCTION AND INEXPENSIVE IN MAINTENANCE

BY ALBERT A. DOWD*

Albert A. Dowd†

IT is of primary importance in the designing of all kinds of cutting tools to bear in mind the fact that all cutting edges must be occasionally sharpened by grinding, and that the re-grinding of the tools brings into use portions which have previously been inactive. This matter deserves the most careful consideration, in order that the design may be such as to give the longest life to the tools consistent with reasonable first cost. In the majority of cases the conditions are such that a little forethought will result in a material improvement in the "upkeep." There are occasional instances, however, when it is very difficult to construct tools so that they will not be seriously affected by re-grinding, as for instance when certain kinds of forming tools are required. A final finishing tool taking a light scraping cut may sometimes be found necessary in cases of this kind, and as this tool will seldom require re-grinding because it has so little to do, the work can be held very close to size.

The designer of cutting tools should have a wide experience and a broad knowledge of the actual conditions under which tools are to be used. He must be capable of thoroughly analyzing the situation and determining the type of tool best suited to the work in question. Examples which illustrate the various types of cutting tools in common use will be described in the following, and attention will be called to features in which there is a chance for improvement, with suggestions tending toward increased life in the tools.

* Address: 221 Grove St., Bridgeport, Conn.
† For biography, see article "Floating Reamer Holders," July, 1913.

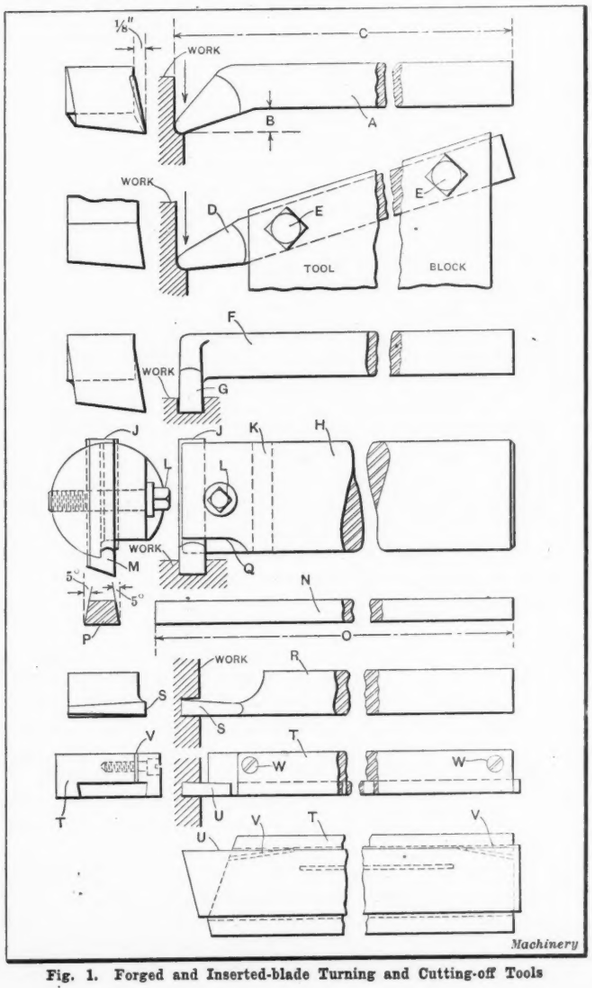



Fig. 1. Forged and Inserted-blade Turning and Cutting-off Tools

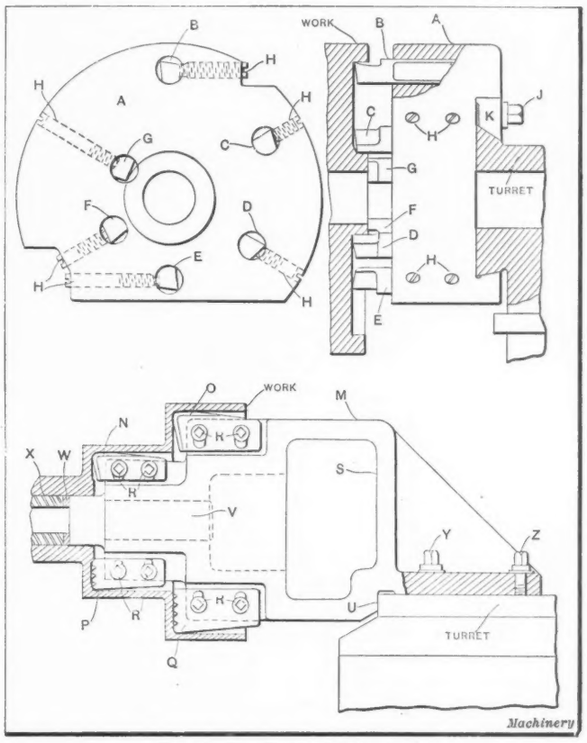



Fig. 2. Two Types of Cutter-heads

## Points in General Design of Cutting Tools

1. The number of pieces to be machined is one of the first things to be considered, as it has a decided influence on the type of tool to be used. A tool designed for machining a small number of parts should be made as cheaply as possible, and the upkeep is not of great importance; but if a great many pieces are to be handled the first cost is not as important as rapidity of action and provision for upkeep.

2. The various materials to be cut—steel, cast iron, brass, etc.—require tools of different shapes, and the clearance angles must be such as to turn the chips to the best advantage.

3. Sufficient clearance for chips is essential in all cases, but should receive special attention when tools are to be used on steel. Internal cutting tools are naturally more subject to chip troubles than those used externally.

4. A copious supply of cutting lubricant is of great assistance in prolonging the life of the tool, as it carries away the heat generated by the cut. If surfaces which are to be machined are so situated that they cannot readily be reached by regular methods of lubrication, it may be found advisable to provide oil channels in the tools themselves.

5. Particular attention should be given to portions of tools subject to slight changes in contour due to re-grinding. Forming tools, shoulder tools, taper reamers, etc., are especially subject to these variations when re-ground. Methods of overcoming these difficulties will be cited in this article.

6. The use of standard sections is advisable when tools of rectangular stock are required, as machining is thereby obviated. It is good practice to use sections such as are carried in stock in the factory where the tools are to be used, so that replacements can be quickly made.

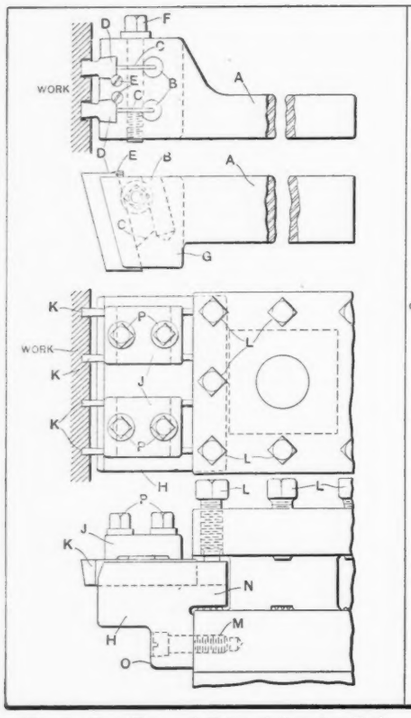



Fig. 3. Two Types of External Grooving Tools

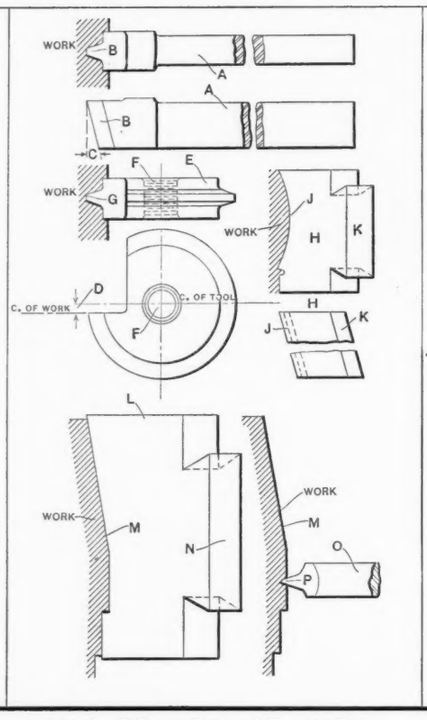



Fig. 4. Different Types of Forming Tools

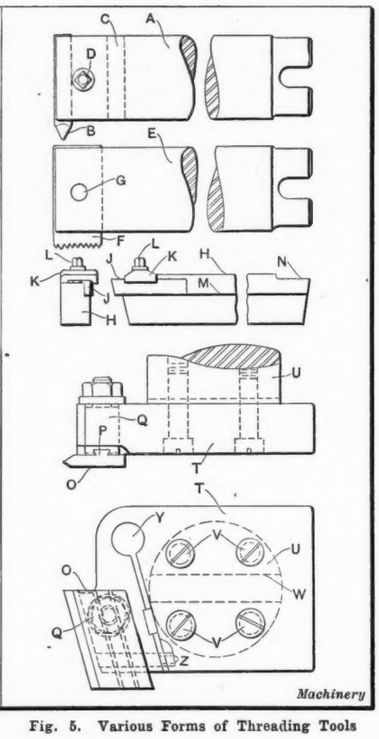



Fig. 5. Various Forms of Threading Tools

7. It should be remembered that "sledge-hammer" methods of adjustment are not conducive to accurate work. Backing-up screws should be provided wherever possible, so that fine adjustments can be made by means of the screws.

8. Generous sizes of stock should be used for cutters whenever possible, as heavier cuts can be taken with tools of large size and they radiate the heat more rapidly, so that the production is increased and the upkeep facilitated. It is obvious that finishing tools may be made much lighter than those used for roughing, as the cuts taken are correspondingly less.

9. Rigidity is an important point and must be carefully considered in regard to the tool itself, its overhang, and the method of holding it. Chatter is fatal to any kind of cutting tool.

10. The original cost of the tool is influenced by many factors. There are many instances when it is advisable to make two or more tools of the same kind, so that replacements may be quickly made in case of accident and so that the cost will be less for each tool than if made at different times.

### Forged Tools and Similar Types

Although forged tools are the simplest of the many varieties of cutting tools, they are greatly abused at times in their application, and much unnecessary expense is incurred by designing them in such a way that re-forging is the only salvation after the tool has been ground a few times. Take, for instance, the forged tool *A* in Fig. 1, which has an offset *B* of $\frac{5}{8}$ inch and a length *C* of 6 inches. Tools of this general type are frequently used on both horizontal and vertical turret lathes. They are very useful at times on account of the facility with which they can be used to cut in either direction. The operation of re-forging tools of this type is simple and comparatively inexpensive. A substitute for this tool may be made as shown at *D*, this type being straight and set angularly in a special tool-block and secured by two screws *E*. The upkeep is thereby made much simpler, as straight stock is used. It may be argued that the cost of the special tool-block will more than offset the extra forging required on tool *A*, and this is true to a certain extent, but when multiple cutting tools are used, a special tool-block is necessary in any case, and it is no more trouble to make it this way than straight. For horizontal turret lathe work, facing and turning tools of this type are much used.

Tool *F* is another type frequently used for cutting an internal recess or groove as shown at *G*. The size is soon lost by re-grinding so that re-forging becomes necessary. In equipments designed for machining a large number of pieces an efficient substitute may be provided as shown by the bar *H*. The end of this bar is cut out in the form of a five-degree dovetail and a tool *J* made to fit it. The bar is split as far back as the drilled hole *K*, and screw *L* is used to draw it together, thus securely binding the tool in any desired position. Attention is called to the manner in which the bar is cut away at *Q* for chip clearance. Tools may be planed up in a strip, as shown at *N*, with a length *O* from twelve to twenty inches and afterward cut off in lengths to suit. The section *P* shows the shape of the strip before grinding. Very little grinding is necessary to produce the required shape. A decided advantage in the use of a bar and tools of this type is the ease with which cutters of various sizes may be made, and the cheapness of upkeep.

One of the most common types of tools is shown at *R;* this is generally spoken of as a parting or cutting-off tool. The life of a tool of this kind is longer than some of the others mentioned when used on small bar work or thin castings, because the cutting portion *S* is quite long and will stand a good deal of grinding before it becomes necessary to send the tool to the blacksmith shop. Another cutting-off tool is shown at *U* and consists of a strip of high-speed steel, ground to fit a special holder *T*. This holder is split at each end at *V*, and two screws *W* hold the tool in place. Considerable economy results from an arrangement of this kind, and the holder may be bought in various sizes. It is one of the products of the Pratt & Whitney Co., Hartford, Conn., and is protected by patents.

### External Grooving Tools

External grooving tools may be required for wide or narrow grooving and may be spaced close together or several inches apart. They may be used in groups of from two to eight or ten, and may be all alike with equal spacing, or entirely different from each other. The writer has selected two designs to represent this type of tooling, both of these being shown in Fig. 3. The one shown at *A* is designed to make two wide grooves on the exterior of a large cast-iron drum as indicated in the illustration. The tool-holder is of tool steel and has a shoulder at *G* which can be brought up against the tool-block, thus acting as a support and giving additional stiffness. Two holes are drilled at *B* and slots *C* are cut to permit a clamping action through screw *F*. Attention is called to the fact that the slots are not cut entirely through the holder, so that

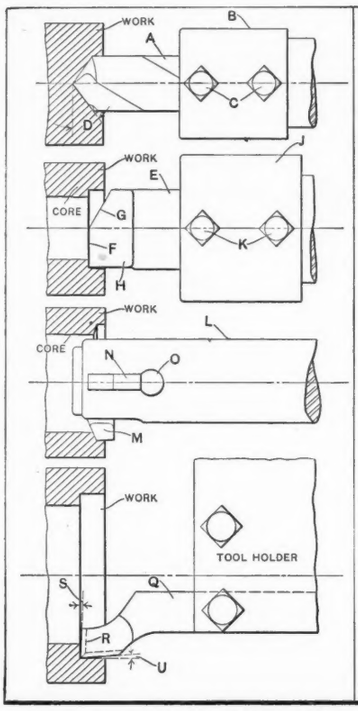



Fig. 6. Starting Tools of Different Kinds

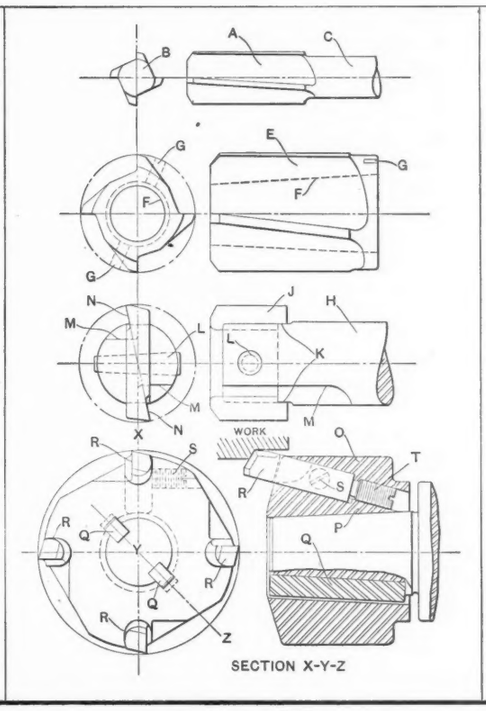



Fig. 7. Core Drills

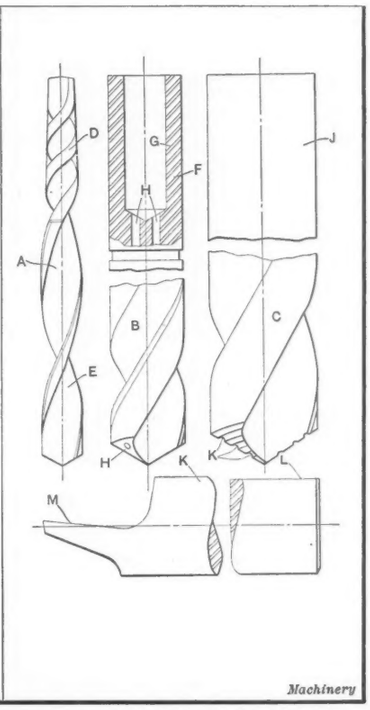



Fig. 8. Twist Drills and Drill for Brass

the lower part remains tied together. The tools *D* are of high-speed steel and are set in the holder at an angle of 15 degrees to give the necessary clearance. The screws *E* permit of easy adjustment. An arrangement of this kind is very economical as far as upkeep is concerned, as tools may be made up in a strip and replaced without trouble when necessary. No grinding is required except on the upper faces.

The lower portion of Fig. 3 shows a group of four narrow grooving tools *K* which are evenly spaced and secured in the block *H*. This block is designed for use in the side head of a Bullard vertical turret lathe. The portion *N* takes the position normally occupied by a forged tool and is secured by the same screws *L* that are ordinarily used to hold the tool. Additional strength is obtained by the extension *O* of the block and the screws *M* which are threaded into the side-head turret. The tools *K* are of high-speed steel and are ground flat on the sides to fit the slots in the block. The steel clamp-blocks *J*, with screws *P*, are used to hold the tools in place. The under side of the clamping block is relieved to gain a good bearing on the tools. Blocks and tools of similar arrangement will be found useful for many purposes, and the cost of upkeep is low.

### Forming Tools

Tools which are so shaped as to produce forms of various kinds are more subject to changes caused by re-grinding than any of the other types. Take the example shown in the upper portion of Fig. 4, in which tool *A* is formed at *B* to cut an angular groove and recess. It will be seen that this tool must be re-ground on the face, and as there must be a slight side clearance to prevent rubbing on the side of the tool, changes in the width of the grooves will take place after the tool has been ground. In addition, there will also be changes in the angle of the groove unless the tool is shimmed up to bring the cutting edge on the center. For a very few pieces a tool of this kind can be used with satisfactory results, but if much work is to be done it is better to make a circular forming tool as shown at *E*. For turret lathe work a special toolpost for either the front or rear of the cut-off slide is used in connection with this type of forming tool. A screw in the tapped hole *F* is used to draw it back and hold it against the finished surface of the toolpost. In order to give proper clearance the cutting edge is offset at *D* an amount varying from ⅛ to ¼ inch, depending on the machine and the size of the work.

For work of larger size, such as that shown at *J*, the dovetail type of tool may be used. Tools of this kind are planed or shaped to the desired form and are set in a special toolpost at an angle of 15 degrees to obtain the necessary clearance. The dovetailed portion fits the tool-holder at *K* and is clamped in position by dovetail hook-bolts. It can be raised or lowered to bring the cutting edge on the center. A form such as that shown can be readily shaped and held to size without trouble if a tool of this type is used. Another dovetail tool is shown at *L*, where the form *M* is to be produced. The dovetail portion *N* fits the toolpost as in the former case. There is a groove to be cut in the work in addition to the form generated by the dovetail tool, but it is not advisable to incorporate this in the same tool, as it might be blunted before the wider faces become dull, so that the whole tool would require re-grinding on this account, which would lessen its life to a great extent. The tool *O* is therefore made to take care of the groove *P*, and is used in the rear toolpost of the cut-off slide. In all cases of forming tools which have to be used for work of a similar kind, an arrangement of this kind is desirable.

### Threading Tools

Tools used for cutting threads are of many kinds. A plain forged tool is frequently used, but its upkeep is expensive when many pieces are to be threaded. On small diameters requiring internal chased threads a forged tool is sometimes necessary on account of the size of the work, but when the work is sufficiently large to permit it, other methods are preferable. For vertical turret lathe work the bar shown at *A* in the upper part of Fig. 5 is furnished by the manufacturers for either outside or inside chasing. The end of the bar is drilled at *C* and a slot cut to provide a means of clamping tool *B* in any desired position through the screw *D*. The tool itself is dovetailed to fit a slot at the end of the bar. The cost of upkeep of a tool of this kind is very small.

The bar *E* may also be designed for use in the vertical turret lathe, but the tool *F*, in this instance, is threaded to the correct pitch for the thread to be cut. A slot in the end of the bar receives the tool, and it is secured in place by the taper pin *G*.

A very useful tool for square threads is shown at *H* and is one of the products of the Pratt & Whitney Co., Hartford, Conn. The holder is of steel and is designed for use in the engine lathe toolpost. The cutters *J* may be obtained for any pitch of thread, and are ground for side clearance. The cutters rest on the shelf *M* on the tool-holder and are clamped in place by means of strap *K* and screw *L*. An elongated hole in the strap permits adjustment for various widths of tools. Either right- or left-hand threads may be

cut with the same holder by simply turning it end for end. If it becomes necessary to sharpen the tool during the progress of the cut, it may be removed from the holder and replaced without disturbing the setting. For high-grade work a roughing cutter of a size slightly smaller than the finishing tool can be used with excellent results. The cost of upkeep of a tool of this kind is very small.

A "goose-neck" holder for a lathe is frequently seen, but is seldom used for turret lathe work. The purpose of a goose-neck holder is to prevent chatter by permitting the tool to spring slightly away from the work. In Fig. 5 a special block of steel *T* is tongued at *W* to fit a slot in the end of the bar *U*, which enters a tool-holder on the turret. The block is secured in place by four screws *V*. The threading tool *O* is dovetailed at *P* to fit a corresponding slot in the block. This slot is planed at an angle to give the necessary clearance to the tool. A binder stud *Q* is dovetailed to fit, and is drawn back by the nut shown. The tool is ground across the upper face only and therefore no change in shape is caused by grinding. A hole *Y* is drilled and slot *Z* cut to allow for spring. A U-shaped spring is adjustable up and down in the slot to give more or less flexibility to the "goose-neck" portion.

### Starting Tools

When a hole of any length is to be drilled in solid stock on a turret machine, it is best to use a short drill to start the hole, afterward following with the regular drill which completes the work. This short starting or spotting drill, being somewhat stiffer than a long one, starts a hole more nearly true and saves wear and tear on the more expensive twist drill. Fig. 6 shows a starting drill at *A* held in a tool-holder *B* by the two set-screws *C*, the shank of the holder being secured in the turret hole. The angle *D* on the end of the drill should be approximately 40 degrees, instead of 31 degrees which is the regular twist-drill angle. By grinding in this way, the lips of the following drill will start to cut before the point, thus giving them a chance to get well into the work before the point begins to guide.

In cast work, when a core drill is to be used, it is advisable to start the hole a trifle smaller than the core drill size with some sort of single-point tool, in order that the drill may start true and not be influenced by variations in the cored hole. There are several varieties of tools used for this purpose, one of these being shown at *E*. This is preferably made of high-speed steel, bright drawn if possible and is cut down to half its diameter at *F*. It is beveled at *G* and slightly back-tapered at *H*, for clearance. It is held in a regular turret tool-holder *J* by two set-screws *K*. A tool of this kind does not deteriorate rapidly.

A chamfering tool is often used prior to a boring-bar and answers the same purpose as the tool just referred to. A combination boring and reaming bar is made by the Bullard Machine Tool Co., Bridgeport, Conn., for use in the vertical turret lathe. A portion of this bar is shown at *L*. The chamfering cutter *M* is of rectangular section and fits a slot in the bar at right angles to the slot *N* which is used for the floating reaming cutters. Pin *O* is flatted to act as a bearing for the latter. All cutters for this bar are of the "slip" variety, and can be readily removed or replaced by the fingers. The cost of upkeep for an arrangement of this kind is small.

When the cored hole is of fairly large size, a forged tool may be used for starting, as shown at *Q*. A tool of this type should be back-tapered at *U* to an angle of 5 degrees and should also have a slight angle at *S*, so that it will not have a tendency to ride up on the scale of the cored hole. The tool is held in a regular tool-holder by set-screws. It should be so set that it will cut slightly smaller than the tool which is to follow it. It may be re-ground a number of times before re-forging becomes necessary,

### Core Drills

A type of core drill much used for small work is shown in the upper part of Fig. 7 at *A*. The shank *C* is integral with the cutting portion. The end view *B* shows one method of milling the flutes. A milling cutter should be selected which has a slightly rounded corner so that the danger of hardening cracks will be lessened. The outside of the fluted portion should be back-tapered from 0.006 to 0.010 inch per foot, in order to give the necessary clearance. Tools of this type are greatly abused in the average shop by improper grinding and by allowing them to become so dull that they cut in such a protesting manner as to be heard all over the factory. Frequently they are so re-ground that only one or two lips are cutting, thereby producing very unsatisfactory results. The shell drill shown at *E* is of the same general type, but it is made so that it fits a taper arbor at *F* and is driven by the

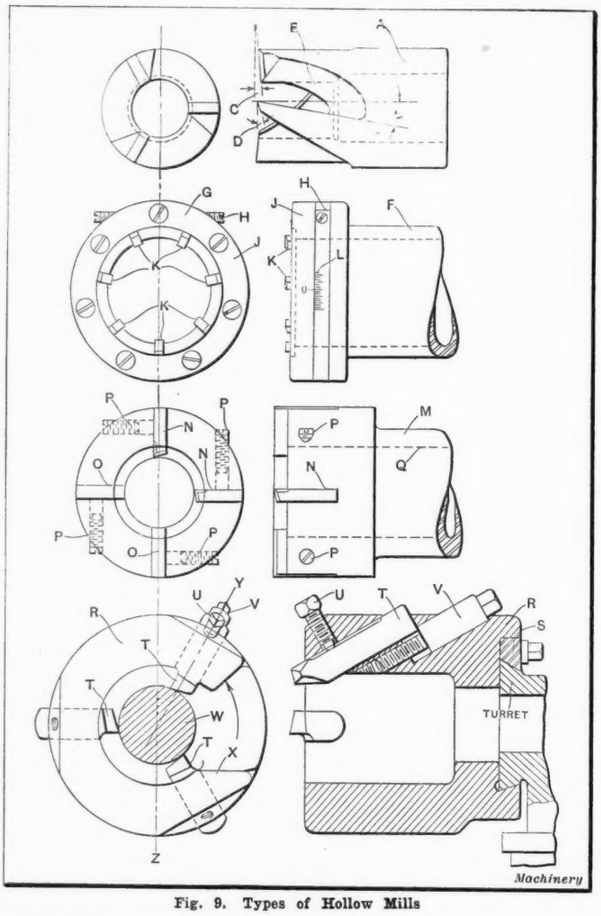



Fig. 9. Types of Hollow Mills

slot *G* in the end, which engages with a tongue on the arbor.

Another type of tool used for the same purpose is shown at *H*. The steel shank is slotted at the end to receive the flat cutter *J*, which is shouldered at *K* to fit the flatted portion of the bar by which it is centrally located. The cutter is held in place by taper pin *L*, and is ground at *N* to bring the cutting edges on the center, or a little ahead of the center which is preferable. The bar is milled out at *M* for chip clearance. The cutter is slightly back-tapered as on a core drill. Tools of this type are much cheaper than core drills and cost less in upkeep, but they will not cut as rapidly as the four-lip type, nor will they produce work as close to size.

The cutter-head shown at *O* is of steel, and was designed for rough-boring automobile cylinders. The action of this tool is much the same as that of a core drill, but replacements are much easier and cheaper. A special grinding arbor is necessary, however, so that the adjusting screws may be more accessible. The body is tapered at *P* to fit the regular arbor shown, and two keys *Q* are provided for driving. The four tools *R* are set angularly in the body, held in place by the screws *S*, and adjusted by screws *T*. The cutting lips *R* are ⅛ inch ahead of the center. The body of the tool is cut away as shown, for chip clearance.

### Types of Drills

In the upkeep of drills a great deal depends upon the care used in grinding and the speeds and feeds used in their operation. The selection of the proper kind of drill to use for a particular job is also of great importance. The flat twisted drill shown at *A* in Fig. 8 is one of the products of the Pratt & Whitney Co., and is adapted for work requiring high speed

and rapid production. The chip clearance on this type of drill is very generous, so that it is especially desirable for steel work. The portion *D* has an increased twist and is ground to fit a regular taper socket.

For deep-hole drilling in steel an oil drill such as that shown at *B* is useful. In this type of drill the shank *F* forms an oil pocket from which the two holes *H* lead to the drill lips. The cutting lubricant system of the machine is piped to the rear end of the drill and the lubricant is forced through the holes. This greatly assists in carrying away the heat generated and also forces the chips out along the flutes. It is sometimes necessary to speed up the pump in order to obtain sufficient pressure to force out the chips. The life of one of these drills is very long. They are one of the products of the Morse Twist Drill & Machine Co., New Bedford, Mass.

When drills are of large size, as shown at *C*, considerable power is required, and they may be made to cut to better advantage if stepped on the lips as shown at *K*. This breaks up the chips so that an easier cutting action is attained. Drills of special form, such as are used on gun barrel drilling machines, are stepped to break the chips in somewhat the same manner as that shown.

For brass or aluminum work a so-called "flat drill" is frequently used on account of the great amount of chip clearance obtained with this type. The cutting lip *M* is ahead of the center and has considerable rake. A flatted portion is milled on the shank *K* at *L*, so that the set-screws in the tool-holder will bear at this point. Tools of this kind are not very expensive and their upkeep is not costly. They should be kept very sharp and the cutting edges should be stoned smooth to secure the best results.

### Cutter-heads

Cutter-heads are not usually designed unless a large number of pieces is to be machined, as they are somewhat expensive and the cost is not warranted if small lots are to be manufactured. In turret lathe practice, when inside work is to be done on a machine having turret longitudinal feed only, a cutter-head may often be used to good advantage. A head designed for a condition of this kind is shown at *A* in Fig. 2. The inside of the rim is to be bored, the hub turned and the web faced. The body of the holder is made of cast iron and is dovetailed to fit the turret face, where it is secured by means of gib *K* and screws *J*. A series of holes is drilled in the face of the head for the tools *B*, *C*, *D*, etc., these being secured in place by screws *H*. The tools are so located in the face of the head that their cutting paths overlap each other slightly so that all of the surface is covered. Tool *B* bores the inside of the casting rim and faces a little of the web. Tool *C* faces part of the web and overlaps the cut produced by *B*. Tools *D*, *E*, *F* and *G* complete the remainder of the web facing and tool *G* also turns the hub. The action of this kind of tool is very satisfactory. Attention is called to the fact that the cutting faces of all the tools except *G* are ahead of the center so that they produce a scraping cut. Tool *G* has its cutting face on the center because it is used for turning and therefore should not be ahead of the center on account of its liability to "dig in."

The lower part of Fig. 2 shows another type of cutter-head that was designed for boring out and facing the inside of a cone pulley. Two heads were made for this work, one for roughing and one for finishing. The heads were identical except for the facing tools, which were "nicked" in the roughing head so that they would attack the scale better. The body of the head *M* is a steel casting cored out at *S* to reduce the weight and fastened down on the turret face by screws *Y* and *Z*. Additional stiffness is secured by permitting shoulder *U* to bear against the edge of the turret. In order to prevent chatter, the forward end is provided with a revolving tool-steel bushing *X* which is a running fit on a stem forced into the body of the tool. A hardened and ground thrust washer *W* is interposed between the bushing and the shoulder on the stem. The tools themselves are of flat high-speed steel, 5/8 inch thick, and are fastened in place by screws *R*. The screw holes are slotted to provide for adjustment. Tools *N* and *P*, although shown in the same plane as *O* and *Q*, are in reality set at right angles to them, so as to distribute the cut to better advantage. The facing tools *P* and *Q* are set slightly nearer the center than the boring tools *N* and *O* so that they do not cut until they reach the shoulder. Although this type of tool does not appear to be very economical as regards upkeep, it is really much better than it appears, as the tools are comparatively inexpensive. Both roughing and finishing tools are used, which is a decided advantage. There is also provision for considerable adjustment in the slotted holes.

### Boring-bars

For small work it is obvious that the cutters in boring-bars cannot be of large size, as the size of the bar will not permit it, nor can much be done in the line of adjusting screws for the same reason. About all that can be done in a case of this kind is to make up a bar something like that shown at *A* in Fig. 10. This bar has a flatted portion at *B* so that it may be firmly held by set-screws in the tool-holder. Tool *C* is of round section, flatted on one side so that the pin *D*, one side of which is flat tapered, can be driven in to hold it in place. Tools of this kind are somewhat difficult to set for diameters, but in turret lathe work, when a machine having a cross-sliding turret is used, diameters may be easily regulated by this feature.

When the work is of a size large enough to permit it, a bar such as that shown at *E* will be found much better and more convenient than that at *A*. The tool *G* is of larger section and is provided with an adjusting screw at *H*. Two set-screws *J* bear against a flat on the tool and hold it firmly. It is now possible to buy high-speed steel of round section very close to size, so that no turning is required on the tool, and the cost of upkeep of a bar of this kind is therefore very small.

For work of still larger diameter the type of bar shown at *K* will be found of advantage. This bar is slotted at the forward end, slightly larger than the thickness of some easily procurable high-speed steel of rectangular section. In order to strengthen the end of the bar a filler block is fitted to the slot and is held in place by two screws *N*. The tool is held in any desired position by the two screws *O*. No adjustment is provided for the tool. The cost of upkeep is exceptionally low.

A very different type of bar is shown at *P*, this being provided with a pilot on the forward end which enters a bushing in the chuck. The bar is made of machine steel and is provided with hardened tool steel bushings *T* which are forced onto pilot *S*. This bar is designed both for boring the large hole and facing the shoulder *Y*, as well as boring the smaller hole which extends completely through the work. The tool *R* is set at an angle of 30 degrees and is held in place by screws *U*. Screw *V* is provided for fine adjustments. The tool *Q* is set into the bar at right angles to the center line in order to facilitate grinding. Backing-up screws and set-screws are provided at *X* and *W*. This bar is cheap as regards the cost of upkeep.

### Counterbores and Kindred Tools

Fig. 11 shows at *A* a counterbore such as is regularly used for screw heads and work of a similar character. Counterbores of this type are made with three, four, five or six flutes, according to the work for which they are required, the most common being four flutes as shown at *B*. Pilots for this type of tool are frequently made removable so that special conditions can be readily met. Tools of this kind may be reground a number of times.

A useful tool for counterboring or cutting shoulders in larger work is shown at *E*. The body of this tool is made of machine steel and is tapered at *F* to some standard taper. Tool *H* is of high-speed steel and is held in position by screws *J*. The end of the holder is slotted at an angle and a filler block *G* is used to strengthen the end, being secured by a screw and dowel. Rectangular stock can be used in this holder and replacements are very easy. A holder of this kind may be used on the lathe, milling machine or turret lathe, as the occasion and conditions may demand.

A counterbore having a removable head and pilot bushing is illustrated at *K*. The stem *M* is of tool steel and is tapered at the rear end to a standard taper. Two keys are provided at *L* to drive the cutter-head, these keys being let in to an enlarged portion of the stem. The cutter-head *K* is shoul-

dered at the rear end and cut out to receive the ends of the keys. The forward end of the stem is reduced in size and tapped out for screw *O* which holds the bushing *N* in place. In an arrangement of this sort a great number of combinations are possible, as heads and pilot bushings may be readily interchanged.

Another type of counterbore having interchangeable guides and heads is shown in the lower view. The construction of this tool is somewhat different from the one above. A holder *P* is slotted at *V* to act as a driver for the cutter-head. The pilot *Q* is reduced in size at *R* and fits hole *T* in the shank, where it is secured by the pointed screw *S*. An angular groove prevents it from turning. The cutter-head *U* is similar to that shown at *K*, and fits the stem *R* of the pilot. A tool of this type is manufactured by the Pratt & Whitney Co., Hartford, Conn., and may be bought in various sizes.

### Hollow Mills

Hollow mills are generally used on bar stock for rapid removal of metal and are usually followed by a box-tool or a single-point turner of some sort. They are not intended for accurate work. Fig. 9 shows in the upper view an ordinary type of hollow mill such as is commonly used in screw machine work. This type of tool is well known. Angle *B* varies from 10 to 15 degrees; angle *C* from 3 to 7 degrees; and angle *D* from 8 to 15 degrees. The back clearance at *E* should be approximately ⅛ inch per foot, or a trifle more. The cutting edges should be on the center for brass, but a trifle ahead of the center for steel. Mills of this type are comparatively cheap. Re-grinding changes the size somewhat, but this may be offset to a certain extent by the use of a clamping ring which draws the cutting lips together. This is not shown in the illustration.

Another form of hollow mill which possesses valuable features of adjustment is shown at *F*. This tool is made by the Geometric Tool Co., New Haven, Conn. It is not designed for heavy cutting, but is especially recommended for brass finishing and light cutting on other metals. It consists of three parts, a holder *F*, a plate *G*, and a cam which controls the cutters. The holder is slotted on the front end to receive the cutters *K;* plate *G* keeps these in place. The diameters are controlled by screw *H* which operates the cutters. An index is provided on the side by which readings to 0.010 inch may be obtained. A hardened plug is recommended for setting the cutters for various diameters.

Another type of adjustable hollow mill is shown at *M*. The body of this tool is made of machine steel and is slotted to receive the two cutters *N* and the back-rests *O*. Screws *P* bind both back-rests and cutters in place when set to the required diameter. The shank *M* fits the hole in the turret. This tool is not suited for heavy cutting, but is quite adaptable to various diameters, and the cutters may be replaced with ease.

The hollow mill shown in the lower part of Fig. 9 was designed for heavy reductions on bar stock in a horizontal turret lathe. The body *R* was made of cast iron and was fitted to the turret at its rear end and drawn up by the dovetailed gib *S*. There were three tools set 120 degrees apart and placed in the holder as shown at *T*. These tools were clamped by screws *U*, while adjustment was provided by backing-up screws *V*. This tool was followed by a single-point turning tool in order to hold the size within the required limits. An opening at the side of the tool was provided at *X* to allow the egress of chips. A plug gage was made to facilitate the setting of the tools and an angular gage for the end of the tools was also found necessary in order that all tools might remove an equal amount of stock. Under test this tool reduced two-inch bar stock to one inch diameter at a speed of 100 feet per minute and a feed of 0.040 inch per revolution.

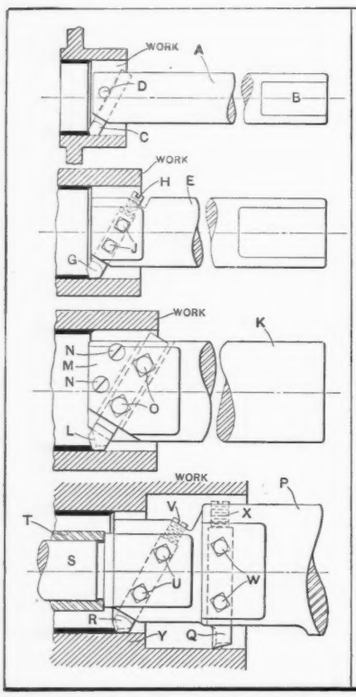



Fig. 10. Boring-bars of Different Types

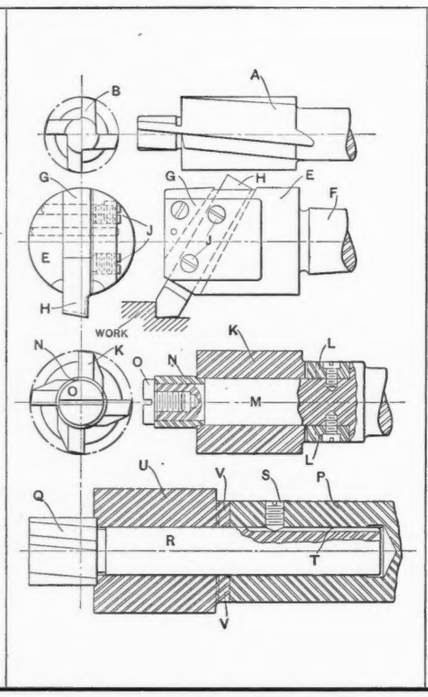



Fig. 11. Counterbores of Different Types

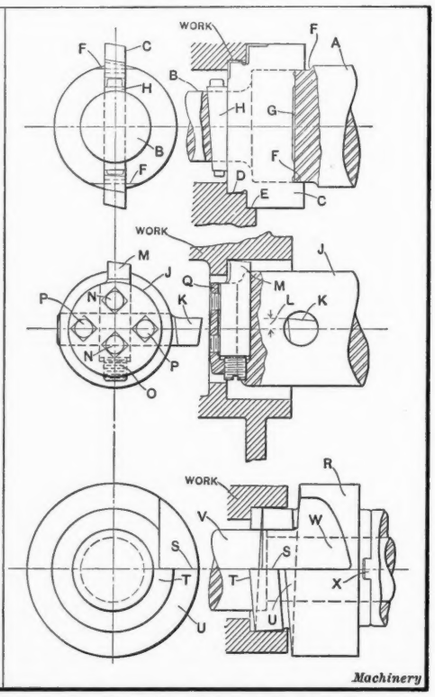



Fig. 12. Three Types of Shoulder Tools

### Shoulder Tools

Great difficulty is sometimes experienced in turret lathe work in keeping shoulder distances uniform after the tools have once been ground. It is therefore advisable, whenever possible, to so design the tools that changes will not take place when they are re-ground. The desired result may sometimes be accomplished by the use of a grinding gage, but it is much better to so arrange the tool that no changes are possible. Several types of shoulder tools are shown in Fig. 12. The one at *A* is piloted with a stem *B* at the forward end in a chuck bushing. A double-ended cutter *C* of high-speed steel fits a slot in the bar and is located sideways on the two flats *F*. A wedge *H* holds the tool back against the rear end of the slot, and all tendency to rock is prevented by the relief at *G*. The faces of the two shoulders *D* and *E* are the important points on this piece of work, and a gage was found necessary in order to keep them uniform when grinding.

Another method of handling a somewhat similar condition is shown in the bar *J*. Two cutters of round section are inserted in the bar at right angles to each other as shown at *M* and *K*. The distance *L* is 3/16 inch, so that this tool would be ahead of the center and would therefore have a scraping

action in facing the end of the hub. The tool *M* used for internal boring and for facing the shoulder is also slightly ahead of the center. The screws *N* hold the tool *M*, while those at *P* secure *K*. The heads of the two screws *N* project about one-half inch more beyond the end of the bar than the other two in order to facilitate the use of a wrench. Some difficulty is experienced in keeping the shoulder distances within the required limit.

A tool which is not affected by re-grinding as far as shoulder distances are concerned is shown at *R* in the lower portion of Fig. 12. In this particular instance, a pilot *V* was used and this extended back through the holder at *W* and acted as a clamp for the cutter-head, being drawn up against it by means of a nut and washer at the rear end of the holder, not shown in the illustration. The holder is provided with a driver at *X* which enters a slot at the rear of the tool proper. The tool *R* is of high-speed steel and is turned to the proper diameters and then given a slight back clearance of about 0.0015 inch to the inch to prevent rubbing. The two cutting faces *U* and *T* are faced with a flat tool on a right-hand spiral having a lead of ¼ inch to the foot. It will be seen that radial re-grinding may be easily accomplished at *S* is driven by a flatted pin in the holder *G*. The pilot *H* enters a bushing in the chuck and is shouldered at *J* to assist in keeping the mill in position. The shank passes entirely through the holder and is secured at the rear end by a nut and washer. A tool of this type may be re-ground considerably without seriously changing the contour. A point worthy of note in the design of face mills which are hand-operated (as in turret lathe practice), is that the lips or cutting faces should be as few as is consistent with the work in question, especially if much surface is to be faced. Too many lips make it difficult to make the mill cut. The mill shown in the illustration was originally designed with eight cutting lips, but it was found that it was about all a man could do to force it to cut on account of the amount of surface to which the cutting edges were presented at once. Four of the lips were therefore ground away; this overcame the difficulty. The approximate diameter of this mill was 3½ inches; it was used on a horizontal turret lathe.

An arrangement for a bottoming tool that can be re-ground without changing its shape is shown in the lower illustration. A bar *K* is held in the turret and is beveled on the forward end to an angle of 30 degrees, and is counterbored

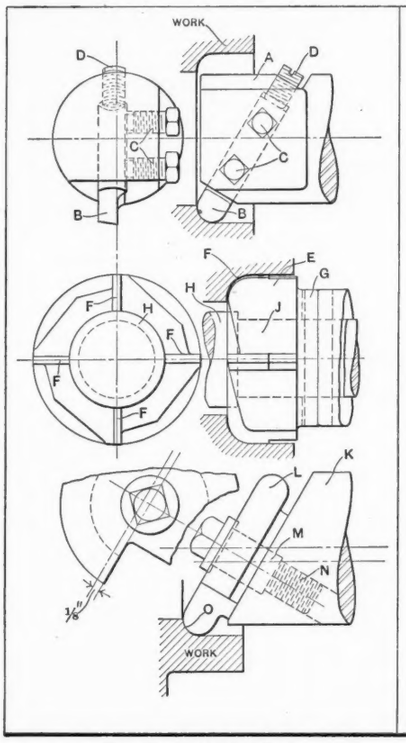



Fig. 13. Bottoming Tools

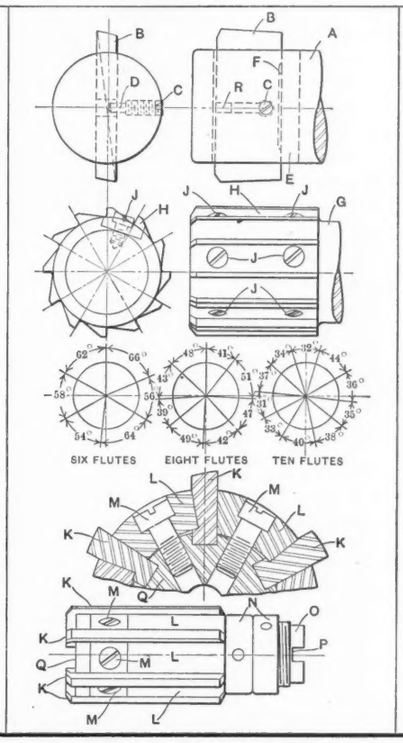



Fig. 14. Finishing Reamers

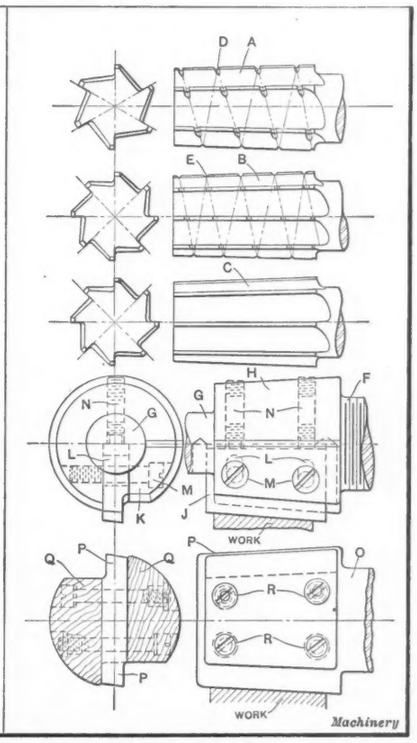



Fig. 15. Taper Reamers

without changing the shoulder distances. There is consequently no danger of variation.

### Bottoming Tools

In automobile construction, ball bearings are often used in the hubs, and the diameters and seats must be carefully machined. As it is not good practice to grind a reamer to a radius such as that shown in the upper portion of Fig. 13, it is necessary to provide some other tool for this work. A simple type is shown in the upper figure, this consisting of a bar *A* having a cutter of cylindrical section, formed at *B* to the proper radius. The cutter is held in place by two screws *C*, adjustment being provided by the backing-up screw *D*. The upkeep for a tool of this kind is expensive, especially if the work on which it is used is a steel casting. Sand spots and blow-holes in this class of material make frequent re-grinding necessary and considerable care must be used in re-setting in order to keep the work within the required limits of accuracy.

Another method of handling a piece of similar work is by means of a face mill having four cutting lips *F* formed to the radius of the seat. The mill *E* is relieved at the rear end and and tapped off center, as shown at *M* and *N*, to receive a shouldered screw which holds the circular forming tool *L* in position. Attention is called to the fact that the center of this tool is ⅛ inch above the center of the work in order to provide the necessary clearance. It will be noted that the form *O* does not change its shape, because the tool is ground radially. The expense of making a tool of this kind is not excessive, nor is the cost of upkeep.

### Straight Chucking Reamers

There are many varieties of adjustable reamers on the market, but very few can be adjusted to cut a certain size without the necessity of re-grinding. Re-grinding, however, is a small matter when compared with the cost of a new reamer. Probably the simplest type of reamer that will produce satisfactory work is that shown in the upper illustration of Fig. 14. The bar *A* fits the turret hole and is slotted at the forward end to receive the flat reamer cutter *B*. The back of this tool is relieved at *F* and bears against pin *E* which is of hardened steel, flattened on one side, and forced into the bar. The screw *C* has a teat *D* which fits loosely into a hole in the reamer cutter, so that a certain amount of "float" is per-

mitted. A tapered cut in tool *B* runs into the hole which the teat screw enters, and a plug *R* may be forced down to open up the blade, thus permitting a number of re-grindings. A reamer of this sort, when used on a horizontal turret lathe, should be turned so that the blade stands vertical in order to minimize errors in the indexing of the turret. It should be lightly guided by the fingers in entering the hole.

The type of reamer shown at *G* is non-adjustable, except if re-ground. In this type of reamer shank *G* is held at the rear end in a floating holder. The forward end is milled out so that a number of blades as shown at *H* may be inserted in the slots and fastened by screws *J*. In milling a reamer of this kind, the blades are inserted and the cutting done on body and blade together. The blades are then taken out and hardened, after which they are assembled and ground in position, both cylindrically and along the faces of the flutes. When a reamer of this kind becomes worn, the blades may be removed and "papered up," and then re-ground. The cost of upkeep on this type of reamer is small.

Occasionally it is desirable to space flutes unequally in order to obviate chatter. It is contended by some that unequal spacing on one half of the reamer answers every purpose and that it only causes extra trouble to space every flute differently; in other words, in an even-fluted reamer the teeth may be opposite each other, thus facilitating calipering; this is, however, doubtful. Unequal spacing for six-, eight- and ten-flute reamers is given in the diagram, and other spacings may be readily determined.

The expansion type of reamer shown in the lower portion of Fig. 14 is made by the Pratt & Whitney Co., Hartford, Conn. A body *Q* fits a taper arbor and is driven by the slot *P* which engages with a pin in the arbor. The blades *K* fit the tapered slots shown in the sectional view. The clamps *L* are drawn down to lock the blades securely by means of the screws *M*. The blades may be set for various diameters within their capacity by means of the two check-nuts *N*. This type of reamer is exceptionally good for turret lathe work.

### Taper Reamers

Taper reamers should always be made considerably longer than the hole which they are to ream in order to provide for long life. In rough-cored taper holes a starting tool or boring-bar should first be used in order to start a true hole, so that the roughing taper reamer may not be influenced by the irregularities of the core. The series of reamers *A*, *B* and *C* shown in Fig. 15 are used for roughing, rough-finishing and final finishing; *A* has six flutes and a series of notches as shown at *D* in order to break the chips and make cutting easier; reamer *B* has eight flutes and also a right-hand thread or groove *E*; the finishing reamer *C* also has eight flutes and may or may not have a groove like that at *E*. If the lead of this groove is not sufficiently great, a series of steps will appear in the finished work. If the taper is very shallow, it may be found necessary to mill the flutes left-hand in order to prevent "drawing-in" and chatter.

A taper scraping tool having a single blade capable of considerable adjustment is shown at *H*. A tool of this type is preferably piloted at *G* in a bushing in the chuck while the rear end is secured firmly in the turret hole. A slot is cut in the body in which the blade *J* is clamped by means of the two screws *M*. These screws pass through the slotted holes *L*, thereby permitting radial adjustment. Two backing-up adjusting screws *N* bear against the back of the blade. The body is cut away at *K* to provide for chip clearance. Shank *F* may or may not be threaded for a collar so as to provide a longitudinal stop. This reamer should be held in such a way that the blade will stand vertically when used in horizontal turret lathe work. This tool has given excellent results.

A cheap taper reamer with which good work can be done is shown at *P* in the lower portion of Fig. 15. The blade *P* is flat and is formed to the desired taper. The portion *O* is permitted to float in a slotted holder driven by a pin. The two pieces *Q* are of maple or some other wood equally good, and are formed to the correct taper, so that they follow the blade and prevent chatter. They are fastened in place by the four screws *R* which pass completely through the blade and enter bushings on the opposite side.

## TOOLPOST FOR HEAVY LATHE WORK

The halftone and line illustrations, Figs. 1 and 2, show a tool designed by Archer Thompson, efficiency engineer at the American Engineering Co.'s plant in Philadelphia, for heavy lathe work. The design of the toolpost provides a solid, rigid support for the cutting tool and enables smaller sections of tool steel to be used more efficiently than is possible with the ordinary type. It thus effects a saving of investment in tool steel and reduces the waste of steel in the shank of the tool to a minimum. With the ordinary toolpost, the length required of a new tool was 10 inches and the dimensions of the stock, ¾ by 1½ inch. With the Thompson style of tool support, it is possible to use tools only 4 inches long, made from stock 1 inch square.

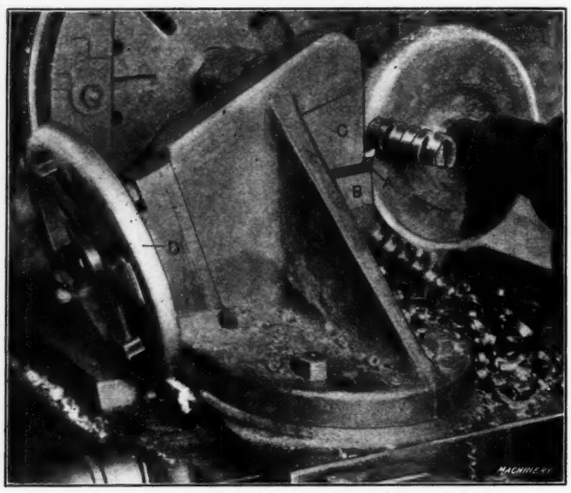



Fig. 1. Special Toolpost designed for Heavy Cutting

Referring to the illustrations for detailed construction, it will be seen that the tool *A* is held between the two sections *B* and *C*, both of which are channeled to receive the 1-inch square tool. The lower part *B* is integral with the base of the toolpost, but the upper part *C* is in the form of a wedge that can be drawn backward toward the operator by the handwheel *D*, this movement causing *C* to clamp the tool *A* firmly in place. In order to provide for tools that have been reground and which are consequently shorter than the standard length, an adjusting screw *E* is used to make up the required length.

The toolpost is secured to the carriage of the lathe by four bolts that may be seen in Fig. 1. This illustration also shows the heavy web provided in the casting to stiffen the toolpost laterally. Notwithstanding the strength and rigidity of the construction, the design is such that the tool and its support can be used effectively in narrow places such as when turning the crank-pins of crankshafts, etc. It is virtually equivalent in this respect to an overhanging tool, minus the overhang.

C. L. L.

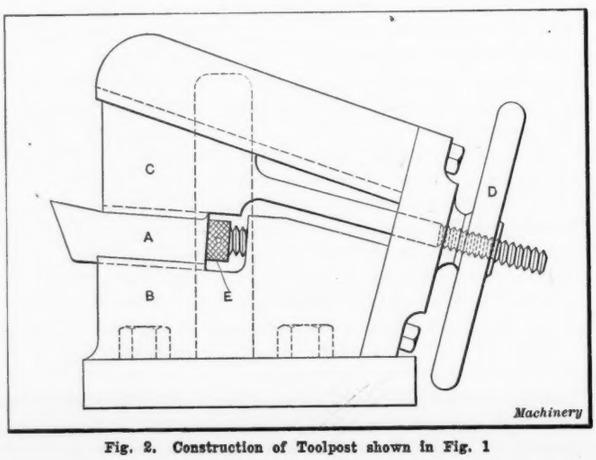



Fig. 2. Construction of Toolpost shown in Fig. 1

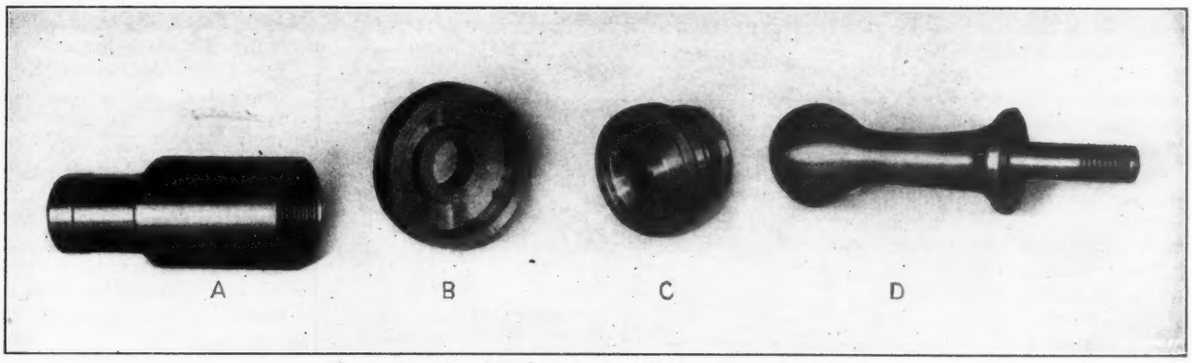



Fig. 1. Examples of Work produced on Model A Cleveland Automatic

# EXAMPLES OF SCREW MACHINE SET-UPS*

## ARRANGEMENT OF TOOLS AND OPERATIONS FOR PRODUCING VARIOUS PARTS ON THE CLEVELAND AUTOMATIC SCREW MACHINE

BY DOUGLAS T. HAMILTON†

ONE of the first points to consider in operating the Cleveland automatic screw machine is the best method of arranging the tools in the turret and on the cross-slide; it is also necessary to take into consideration any peculiarities in the shape of the work, and decide whether the job can best be handled by standard tools or turned out more quickly and efficiently by designing special tools. If large quantity production is to be provided for, it is sometimes advisable to design special tools, as is necessary in all classes of machinery. For small quantity and large variety, the standard tools are adaptable. These various points should be taken into consideration by the operator before starting to lay out a set of tools for producing any given piece of work. In the following article, four typical jobs are taken as examples, and the various points in connection with these are illustrated and described.

### Example 1

We will take for our first example the special chrome-nickel steel sleeve shown at *A* in Figs. 1 and 3. The requirements for this part are comparatively simple, *viz.*, drilling, long forming, producing a body concentric with the bore, and recessing. It will be seen that there is nothing unusual about this job, so no special equipment is required. A 3¼-inch model A automatic screw machine with a No. 4 spindle drive is used. As shown in Fig. 2, the operations would then take the following order:

First, gage stock to length by a gage stop *A* in the first hole in the turret.

Second, index turret and rough-turn large diameter with cutter *a*, using an overhanging turning attachment *B*, and at the same time drill large hole full depth, using drill and split holder *C* in second hole in turret; time of operations, 3 minutes and 35 seconds.

Third, index turret and finish-turn large diameter with second cutter *b* held in turning attachment, and at the same time counterbore large hole, using counterbore and holder *D* held in third hole in turret. As no tools are in the way on the front side, forming tools *E* and *F* can be brought into operation to face the end and to form the rear diameters, using flat forming tools and toolpost and an open-side toolpost on the front of the cross-slide. The time for these operations is 4 minutes and 30 seconds.

Fourth, index turret and drill small hole, using drill and split holder *G* in the fourth hole in the turret. Time of operation is 2 minutes and 15 seconds.

Fifth, index turret, recess, using a recessing tool and holder *H* in the fifth hole in the turret. The operating cam for effecting a movement of the recessing tool is held on the front of the cross-slide. Time of operation is 1 minute, 25 seconds.

Sixth, index turret and bring tap-holder *I* and tap held in sixth hole, into operation. The time for threading this piece is 1 minute and 45 seconds

Seventh, cut off, using cut-off blade *J* held in a universal cut-off toolpost on the rear of the cross-slide. Time for operation is 1 minute and 30 seconds. Total time for the entire operations enumerated, including the idle motion of the machine, is 15 minutes.

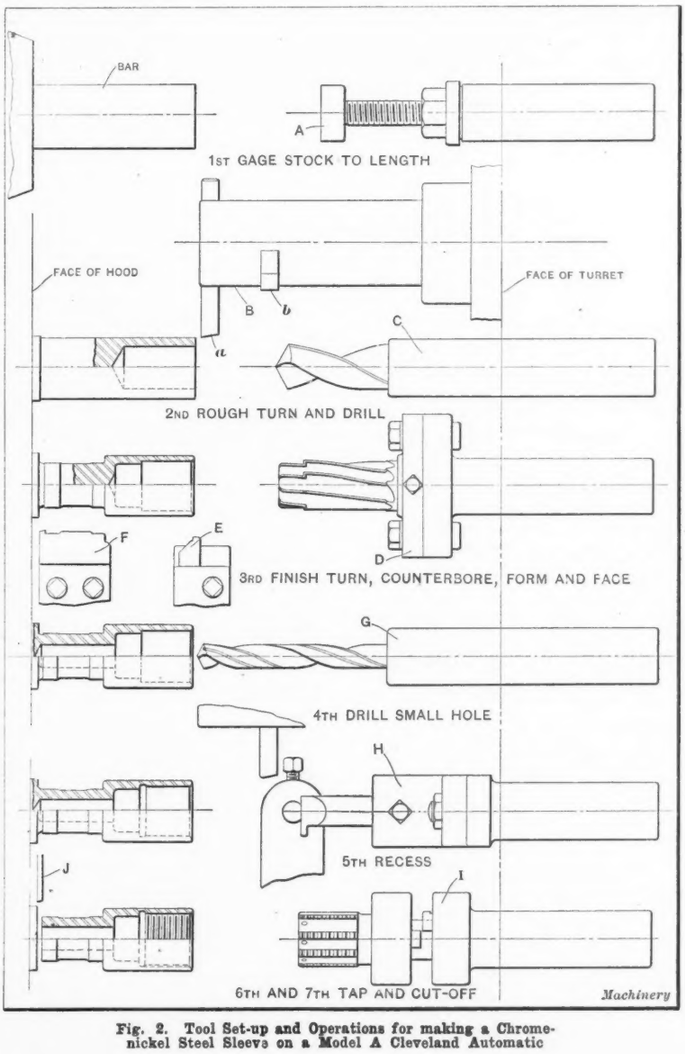



Fig. 2. Tool Set-up and Operations for making a Chrome-nickel Steel Sleeve on a Model A Cleveland Automatic

* For previous articles on Cleveland automatic screw machine practice, see "Operating Automatic Screw Machines," October, 1914, and articles there referred to.

† Associate Editor of MACHINERY.

When the tools have been set in their proper relation to each other, and the feed-regulating cams have been so adjusted as to give the proper feeds for the various tools, the position of the various cams is noted and recorded on a chart, a copy of which is shown in Fig. 4. All the tools are recorded on this chart, so that when an operator comes to set the same piece up again he can refer immediately to the tools that were used and can set them in the positions in which they were found to give the best results. This makes the second setting-up very simple.

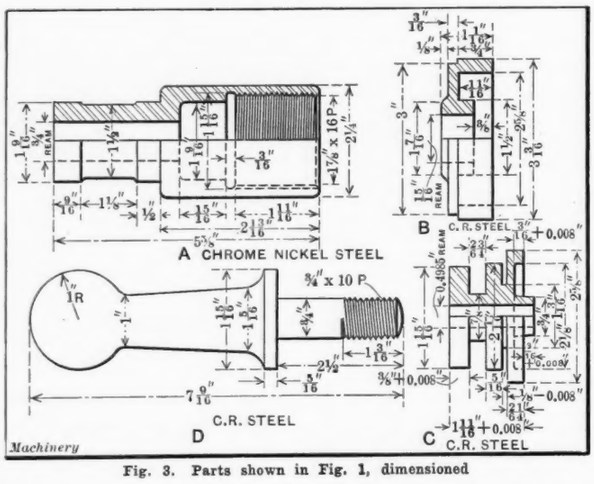



Fig. 3. Parts shown in Fig. 1, dimensioned

Example 2

Another comparatively simple piece of work to produce on the Cleveland automatic is shown at *B* in Figs. 1 and 3. This job can be handled best as shown in Fig. 9 on a 3¼-inch model A machine, using the No. 1 drive:

First, feed stock to stop *A*, which is held in first hole in turret.

Second, index turret and drill hole full depth, using drill holder *B* in the second hole in the turret. Time for operation, 50 seconds.

Third, index turret and finish-turn outside diameter with overhanging turning attachment *D*, carrying two cutting tools—tool *a* for roughing and tool *b* for finish-turning. At the same time counterbore hole, using a counterbore held in holder *E* in the third hole in the turret, and form and face with tools *F* and *G* which are held on the front part of the cross-slide, using a post with flat cutters and spacing blocks to set them the correct distance apart. Time for the operation, 3 minutes and 55 seconds.

Fourth, index turret and finish-turn with second cutter *b* in overhanging turning attachment *D*, and ream hole, using a reamer and floating holder *H* carried in the fourth hole in the turret. The time for these two operations is 18 seconds.

Fifth, index turret and cut off with a universal cut-off tool blade *I* and post held on the rear of the cross-slide. Time, 32 seconds. The total time, including the idle motions for chucking, advancing and withdrawing the turret and indexing, is 5 minutes and 35 seconds.

The arrangement of the forming and cutting-off tools is shown in Fig. 6. All the data obtained from the setting-up of this job is recorded on the operation sheet shown in Fig. 5, as well as any particular features necessary to turn this job out more effectively. All the tools and attachments are

Form 16 W

**Position of Tools and Cams on the Cleveland Automatic Turret Machines**

For A. L. Schutte — Size of Mach. 2⅝ - 3¼ Model A

Sample No. 1 — Order No. 36454 — Serial No. 12484

| Position of Turret Tools | | Note position of hand on dial to set Regulating Cams for Feed |
|---|---|---|
| 1 | Gage stop | 1 40, 10 14 |
| 2 | 1 35/64" Drill & holder | 2 30, 20 35 |
| 3 | Counterbore | 3 33, 30 41 |
| 4 | 51/64" Drill & holder | 4 36, 40 37 |
| 5 | Recessing tool & holder | 5 41, 50 40 |
| 6 | Tap | 6 17, 60 0 |

**Position of Cross Slide Cams**

| | |
|---|---|
| A | 82 |
| B | 34 |
| C | 101 |
| D | 48 |
| E | 117 |
| F | |
| G | |
| H | |
| I | |
| J | |

CROSS SLIDE DRUM

Tools on Front of Cross Slide: Open-side post - facing tool - forming and recessing lever

Tools on Rear of Cross Slide: Universal cut-off tool

| | |
|---|---|
| Output 4 per hour | Extra Tools and Attachments |
| R. P. M. of Countershaft 300 | Turning attachment |
| Size of Flange Pulley 16" | Third speed left hand |
| Size of Spindle Pulley 16" | Short forwarding turret cam |
| Pins in Regulating Drum Outside 7 | |
| Pins in Regulating Drum Inside 7 | |
| Position of Turret Head Between F & G | |
| Remarks: Special feed pulley on this job 16" | |

Tested with Cold-rolled steel — Operators Sloss and Carpenter

Fig. 4. Chart indicating Position of Tools and Cams on the Cleveland Automatic for making the Part shown at A in Fig. 1

Form 16 W

**Position of Tools and Cams on the Cleveland Automatic Turret Machines**

For Dayton Engineering Laboratories Co. — Size of Mach. 3 1/4 Model A

Sample No. 2 — Order No. 9981 — Serial No. 8642

| Position of Turret Tools | | Note position of hand on dial to set Regulating Cams for Feed |
|---|---|---|
| 1 | Gage stop | 1 35, 10 35 |
| 2 | Drill and split holder | 2 36, 20 38 |
| 3 | Counterbore and holder | 3 36, 30 40 |
| 4 | Floating reamer & holder | 4 42, 40 44 |
| 5 | | 5 44, 50 44 |
| 6 | | 6, 60 |

**Position of Cross Slide Cams**

| | |
|---|---|
| A | 100 |
| B | 50 |
| C | 48 |
| D | 117 |
| E | |
| F | |
| G | |
| H | |
| I | |
| J | |

CROSS SLIDE DRUM

Tools on Front of Cross Slide: Flat forming post with high-speed cutters — cutting above

Tools on Rear of Cross Slide: Universal cut-off tool and post — cutting below

| | |
|---|---|
| Output 100 per hour | Extra Tools and Attachments |
| R. P. M. of Countershaft 390 | Turning attachment |
| Size of Flange Pulley 14 " | Oil feed attachment |
| Size of Spindle Pulley 22 " | |
| Pins in Regulating Drum Outside 5 | |
| Pins in Regulating Drum Inside 5 | |
| Position of Turret Head II | |
| Remarks | |

Tested with 3 1/4 Cold-rolled steel Operator Kliment

Fig. 5. Diagram showing Position of Tools and Cams on the Cleveland Automatic for making the Clutch Case shown at B in Fig. 1

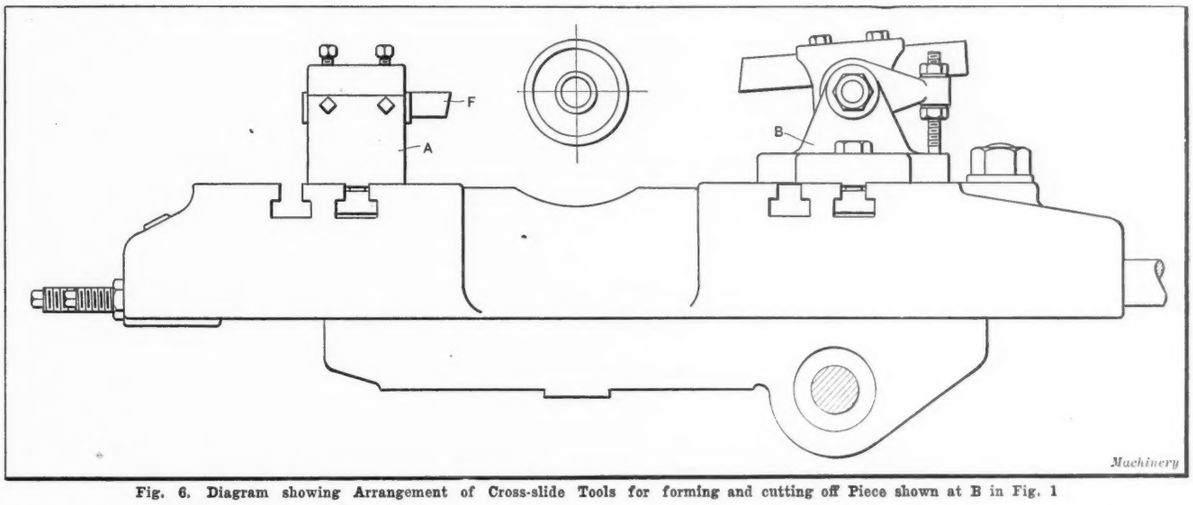



**Fig. 6. Diagram showing Arrangement of Cross-slide Tools for forming and cutting off Piece shown at B in Fig. 1**

noted under the various headings on the sheet, as well as the size of the pulleys, number of pins in the regulating drum, and other points regarding the proper setting-up of the machine.

### Example 3

Referring to the twin gear blank shown at *C* in Figs. 1 and 3, it will be noted that the greatest amount of work on this piece is to be done from the cross-slide; also that the drilling depth is considerable, so that the best way to lay out this job would be to use two drills, one going in part way and the other the remainder of the distance. Referring to Fig. 10, which shows the set-up for this job, the operations take the following order on a 3¼-inch model A machine with a No. 1 drive.

First, gage stock to length by stop *A* held in the first hole in the turret.

Second, index turret and turn part way with tool *a* in overhanging turning attachment *B* carrying two turning tools, and drill part way, using high-speed drill held in holder *C* in second hole in turret. Time for the two operations, 40 seconds.

Third, index turret and finish-turn, using second cutter *b* in overhanging turning attachment *B*, and drill full depth, using a high-speed drill-holder *D* held in the third hole in the

**Position of Tools and Cams on the Cleveland Automatic Turret Machines**

For Harley-Davidson Motor Co. Size of Mach. 2" - 2⅝ Model A

Sample No. 3 Valve Lifting Cam Order No. 35969 Serial No. 11818

| Position of Turret Tools | | Note position of hand on dial to set Regulating Cams for Feed | |
|---|---|---|---|
| 1 | Gage stop | 1 36 | 10 36 |
| 2 | 1/2" Center drill | 2 37 | 20 38 |
| 3 | 31/64" Drill | 3 38 | 30 39 |
| 4 | 1/2" Reamer | 4 41 | 40 42 |
| 5 | Counterbore | 5 42 | 50 33 |
| 6 | | 6 | 60 |

**Position of Cross Slide Cams**

| | | CROSS SLIDE DRUM |
|---|---|---|
| A | 53 | |
| B | | |
| C | 21 | |
| D | 69 | |
| E | | |
| F | | |
| G | | |
| H | | |
| I | | |
| J | | |

Tools on Front of Cross Slide

Flat forming and facing tool

Tools on Rear of Cross Slide

3 grooving tools - flat "high" post

| | |
|---|---|
| Output 10 per hour | Extra Tools and Attachments |
| R. P. M. of Countershaft 460 | Independent cutting-off attachment |
| Size of Flange Pulley 10" | 3 High-speed Drills |
| Size of Spindle Pulley 16" | |
| Pins in Regulating Drum Outside 4 | |
| Pins in Regulating Drum Inside 4 | |
| Position of Turret Head G | |

Remarks 8" face pulley on countershaft for high-speed drill drive

Tested with 2 5/8 cold-rolled steel Operator Kratz

**Fig. 7. Diagram showing Position of Tools and Cams on the Cleveland Automatic for producing the Part shown at C in Fig. 1**

**Position of Tools and Cams on the Cleveland Automatic Turret Machines**

For Schuchardt & Schutte Size of Mach. 2 3/4 Model A

Sample No. 4 Order No. 8357 Serial No. 7891

| Position of Turret Tools | | Note position of hand on dial to set Regulating Cams for Feed | |
|---|---|---|---|
| 1 | Gage stop | 1 28 | 10 32 |
| 2 | K-3 Box-mill | 2 32 | 20 28 |
| 3 | Roller steady rest | 3 25 | 30 30½ |
| 4 | Self-opening die | 4 36 | 40 23 |
| 5 | | 5 6½ | 50 19 |
| 6 | | 6 | 60 |

**Position of Cross Slide Cams**

| | | CROSS SLIDE DRUM |
|---|---|---|
| A | 91 | |
| B | 48 | |
| C | 118 | |
| D | | |
| E | | |
| F | | |
| G | | |
| H | | |
| I | | |
| J | | |

Tools on Front of Cross Slide

Flat forming tool and post — cutting above

Tools on Rear of Cross Slide

Cut-off tool special — cutting below

| | |
|---|---|
| Output 9 per hour | Extra Tools and Attachments |
| R. P. M. of Countershaft 335 | |
| Size of Flange Pulley 14" | |
| Size of Spindle Pulley 22" & 10" | |
| Pins in Regulating Drum Outside 5 | |
| Pins in Regulating Drum Inside 5 | |
| Position of Turret Head J | |

Remarks

Tested with 2 1/16 cold-rolled steel Operator Pratt

**Fig. 8. Diagram showing Position of Tools and Cams on the Cleveland Automatic for producing Part D in Fig. 1**

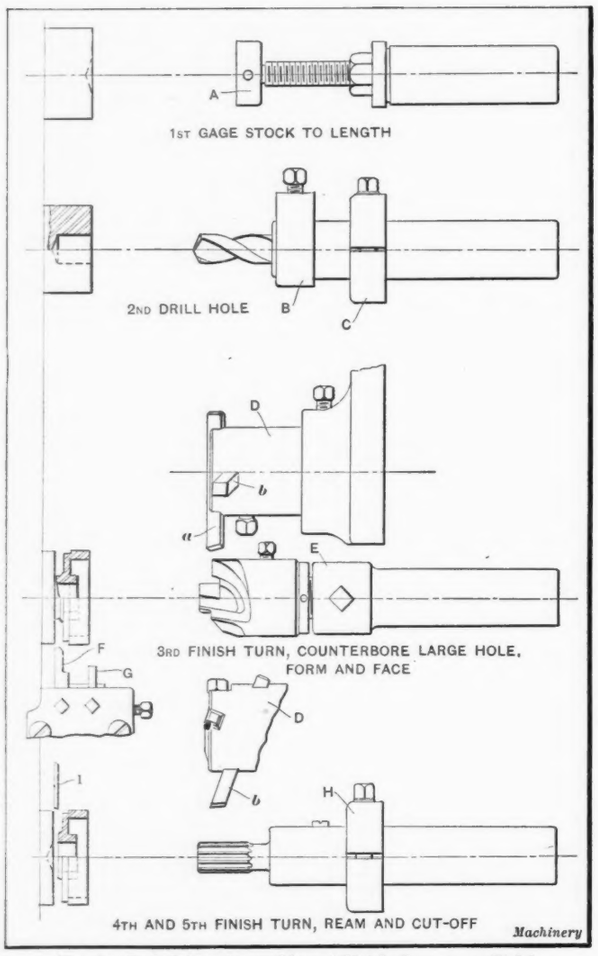



Fig. 9. Tool Set-up for making a Clutch Case on a Model A 3¼-inch Cleveland Automatic

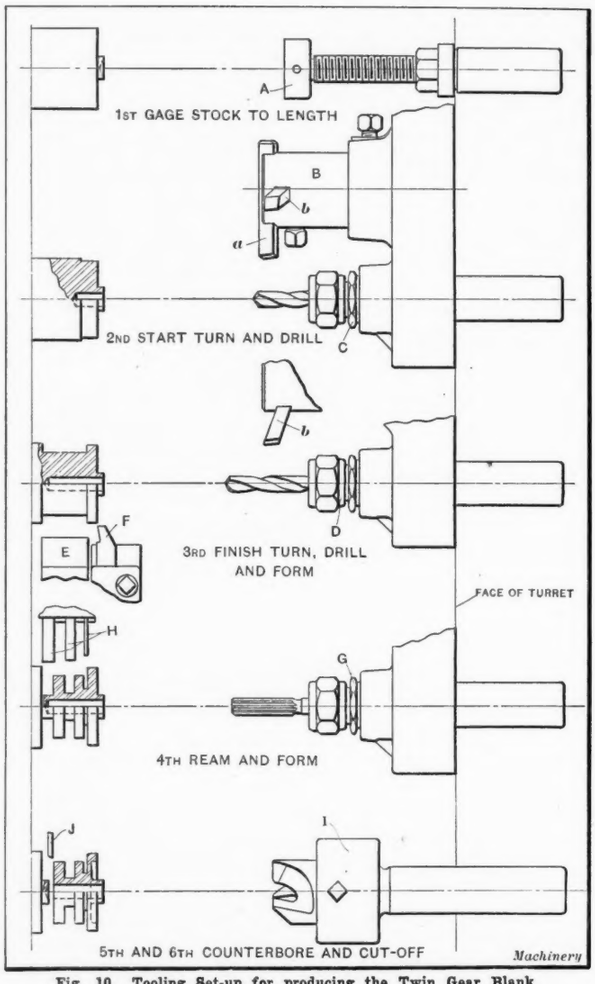



Fig. 10. Tooling Set-up for producing the Twin Gear Blank shown at C in Fig. 1

turret. At the same time advance tools *E* and *F* held on the front of the cross-slide and start forming the rear diameters. Also take cut on front face, using flat forming tool *F* and open-side toolpost on front of cross-slide. Time for operations, 1 minute and 55 seconds.

Fourth, index turret and ream hole, using a reamer held in a high-speed drill-holder *G* in the fourth hole in the turret. The use of two drills on a hole of this depth avoids the necessity of using a boring tool, and the reamer in this case can be held in a rigid instead of a floating holder. At the same time that the reaming operation is being accomplished, three cutting blades *H*, held on the rear of the cross-slide and separated by flat spacing blocks, are brought into action. The grooving blade nearest the chuck is made considerably wider than the requirements of the work demand and is used for roughing the front end of the next piece. Time for operations, 3 minutes, 40 seconds.

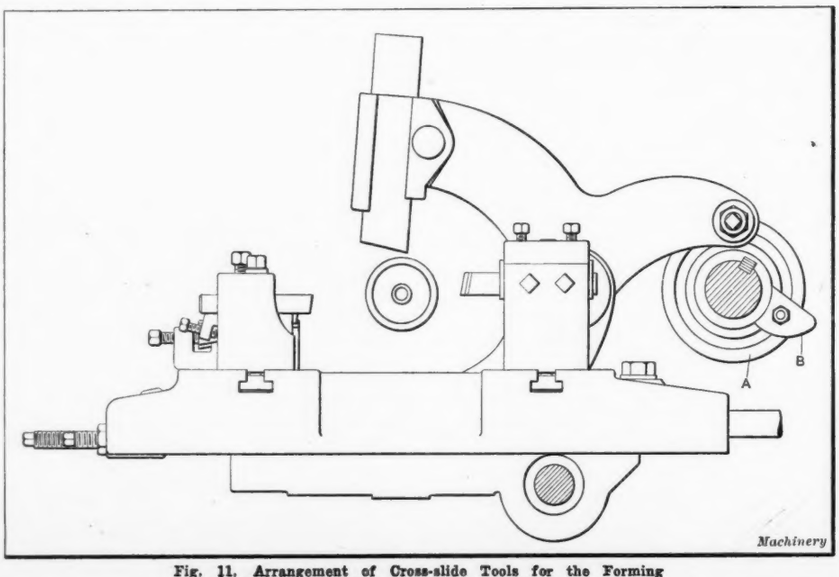



Fig. 11. Arrangement of Cross-slide Tools for the Forming and Cutting-off Operations on the Part shown at C in Fig. 1

Fifth, index turret, and counterbore with tool held in holder *I* in fifth hole of turret. Time for operation, 1 minute.

Sixth, cut off with blade *J*, using independent cut-off attachment shown in Fig. 11, and index turret twice. Time for operation, 35 seconds. Total time, 7 minutes and 50 seconds.

This is an example where there was considerable forming to be done from the cross-slide, which could not be handled efficiently with only one set of tools, that is, using only one end of the cross-slide for forming tools. Consequently, both ends of the cross-slide, as shown in Fig. 11, are utilized and the work is then cut off by the independent cut-off attachment shown. The operation of this attachment was described in a previous article and therefore needs little mention here. A special cam disk *A* is held on the rear shaft carrying a cam *B*. This is adjustably mounted in the T-slot groove cut in the side of the disk and can be set in any desired position. This cam comes in contact with a

roll carried in the rear end of the fulcrumed arm of the attachment, raising it up and consequently depressing the front end and advancing the cutting-off tool toward the center of the work.

Referring to the set-up chart shown in Fig. 7, it will be seen that all the tools, positions of the cams, etc., have been recorded on this sheet. It will also be noted that an 8-inch pulley is used on the countershaft for driving the high-speed drill. This is a special attachment held in the turret which was described in a previous article. Notation is also made of the independent cutting-off tool attachment, and also three high-speed drill holders. The information given concerning setting the cutting-off tool "high" should be noted, because in this case the work is not reversed, no threading operation taking place, so that the tools on the rear of the slide, instead of being set "low" are set "high" and cut with the stock rotating in the forward direction.

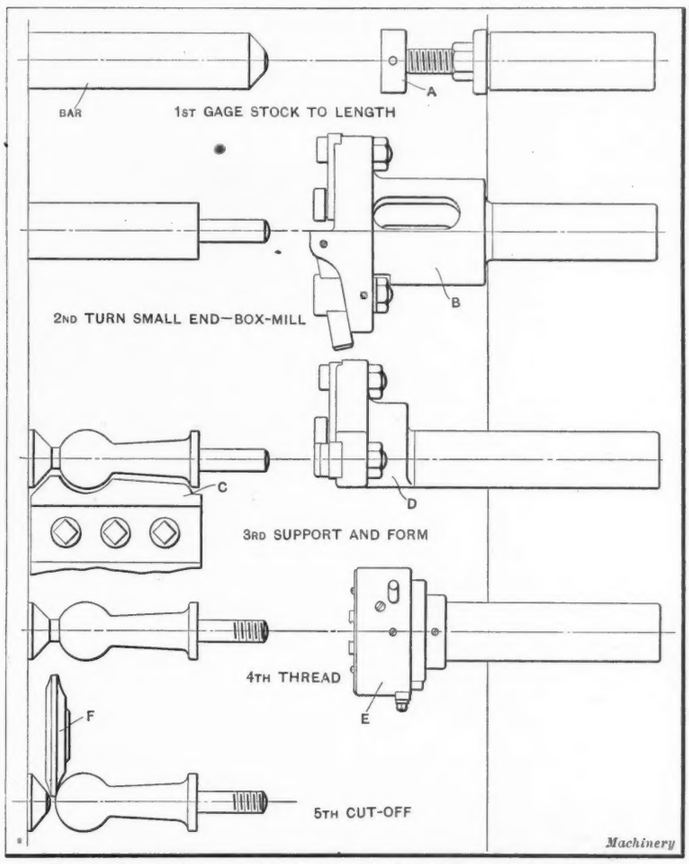



Fig. 12. Tool Set-up for producing the Stanchion Bolt shown at D in Fig. 1

Example 4

The stanchion bolt *D*, Figs. 1 and 3, brings up a point in the operation of the Cleveland automatic that is worthy of special attention; that is, the handling of long forming operations, especially on steel parts. This can be done much more efficiently by means of a long flat forming tool than by a circular forming tool. There are two reasons for this: First, the flat forming tool gives much better side clearance than the circular tool; second, the flat forming tool can be held much more rigidly and heavier cuts can be taken with it. It is also much cheaper to make. The only other point of interest about this job is the use of a self-opening die-holder. The use of this type of die cuts down the time necessary for threading, as the die does not need to be backed off but is opened as soon as the thread is completed, and the turret can be drawn back on the fast speed.

Referring to Fig. 12, it will be seen that the operations are handled in the following order, a 2¾-inch model A No. 1 spindle drive machine being used:

First, gage stock to length with gage stop *A* held in first hole in turret.

Second, index turret and turn down stem with No. K-3 box-tool *B* held in second hole in turret. Time for this operation, 1 minute and 30 seconds.

Third, index turret and form irregular shape, using flat forming tool *C* held on front of cross-slide, and supporting work at same time with a roller steadyrest *D* held in third hole in turret, running on the stem of the work. Time for this operation is 3 minutes and 20 seconds.

Fourth, index turret and thread, using a self-opening die-head *E* in fifth hole in turret. Time for operation is 35 seconds.

Fifth, cut off, using circular cut-off tool *F* held on rear of cross-slide. Time, 45 seconds. Total time, including all the idle movements, 6 minutes and 15 seconds.

The arrangement of the tools held on the cross-slide is clearly indicated in Fig. 13. Referring to this illustration, it will be seen that the flat forming tool *C* is mounted on a wedge *A* for vertical adjustment. The forming tool is held down by the cap-screws and the wedge is adjusted by a set-screw *D*. Another set-screw *E* backs up the forming tool, supporting it much more rigidly. The cut-off tool is held on the rear forming slide and is turned upside down so that the spindle need not be reversed, the cutting off being done with the stock running in the forward direction.

The tool set-up shown in Fig. 8 gives all the particulars regarding this job that would be needed by the operator when setting it up for a second time. While these examples that have been chosen are comparatively simple as regards tooling equipment they nevertheless illustrate points in the operation of the Cleveland automatic screw machine that are worthy of note.

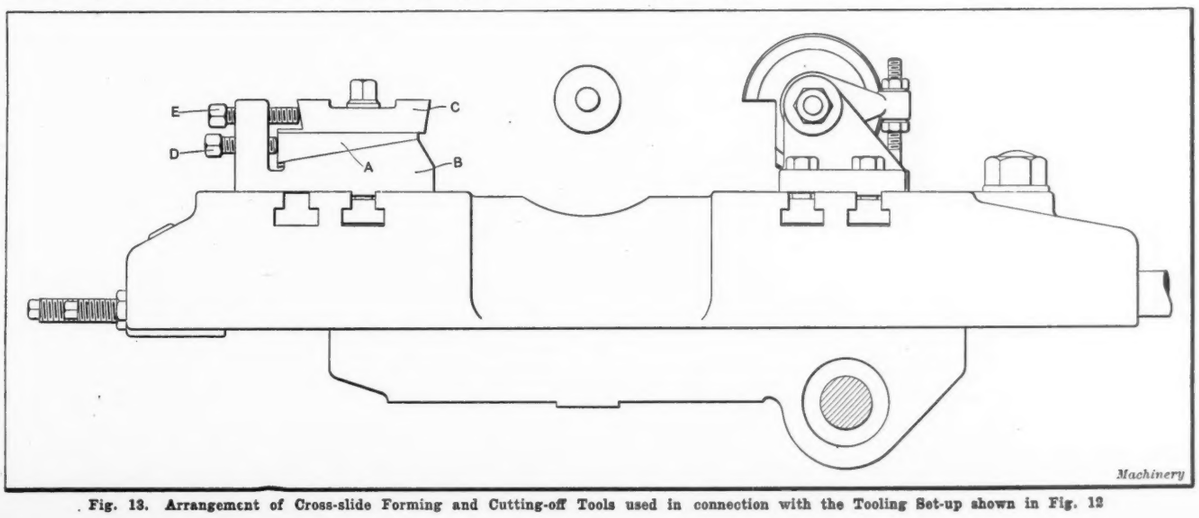



Fig. 13. Arrangement of Cross-slide Forming and Cutting-off Tools used in connection with the Tooling Set-up shown in Fig. 12

# RING WHEELS AND SOLID WHEELS FOR DISK GRINDING

## NOTES ON ECONOMICAL METHODS OF MACHINING PARTS WITH DISK GRINDERS

BY A. J. MATHISON*

WITH the advent of the modern disk grinding machine and the greater efficiency of the artificial abrasives such as carborundum and alundum as compared with emery, the use of ring and disk wheels is supplanting the shaper and milling machine for many classes of work, and is reducing the cost of production from 50 to 90 per cent. The abrasive cloth disks have proved the economy of disk grinding as far as the time required for finishing a piece of work by grinding, as compared to milling or shaping, is concerned; but their wider application for finishing work on the disk grinder has been retarded because of the high cost of the abrasive cloth disks, due to the cloth, glue, emery and labor that enter into their manufacture. The experience of the past two years has proved conclusively that the solid ring and disk wheels can successfully take the place of cloth disks for all classes of work except, perhaps, the use of the finer grained disks from No. 46 up; and each year will see the

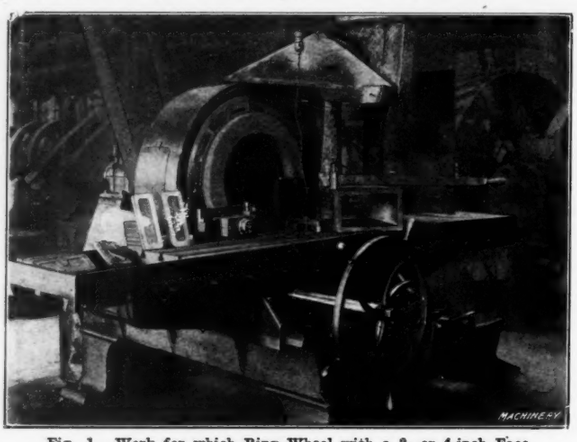


Fig. 1. Work for which Ring Wheel with a 3- or 4-inch Face is well suited

fine grained solid wheels doing more of this work, until the general use of cloth disks will not be considered practical.

The ring wheel must not be confused with a wide faced solid wheel, because a ring wheel is one that has a working face of from 1 to 4 inches, and all work ground on these wheels must be securely fastened in a jig or fixture when passed across the face of the wheel, whereas "floating" or applying the work free-hand to the face of the wheel is the method employed when a wide-faced wheel or disk is used. The wider faced ring wheels with a working face of from 3 to 4 inches or more are well adapted for much work that is now being ground on the so-called "edge" or surface grinders which are usually supplied with a wheel having a 2-inch working face. Such a piece of work is shown in Fig. 1.

The larger sizes of single-head disk grinding machines fitted with 18- or 20-inch ring wheels mounted in "Perfection" chucks and having a geared lever feed table are preferable to the 24-inch edge grinder for handling small or medium sizes of work. The disk grinding machines are well designed and the table traverse on machines equipped with the swinging lever table is easily operated. The ways of the table are dust-proof and have no lost motion, so

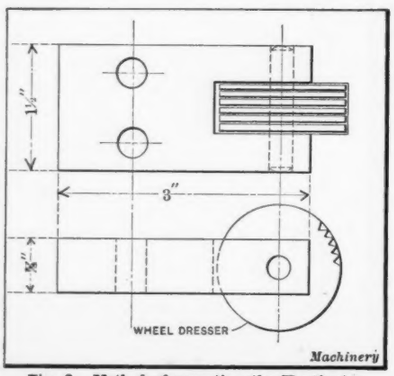



Fig. 2. Method of mounting the Huntington Wheel Dresser

* Address: 911 Church St., Beloit, Wis.

Fig. 3. Grinding Parallel Surfaces on a Double-head Machine equipped with Sliding Table Attachment

that good work can be obtained. When used dry, the ways of edge grinders wear out because they are not dust-proof. It is hard work to operate the table by hand if the ways are fitted close, and with the lost motion which exists when the table runs loose on the ways, satisfactory results cannot reasonably be expected. In the writer's opinion, only automatic edge grinders equipped with water attachments which prevent the dust collecting on the ways, and with power traverse and close adjustment of the ways should be used.

Where a wide-faced ring wheel is to be used on a 24-inch edge grinder, the ring wheel should be 24 inches in diameter by 6 inches wide, with a face width of 3½ inches, which makes the diameter of the hole 17 inches. A 16-grain, grade O alundum wheel is recommended for general use on cast iron, malleable iron, steel or brass. When a 2-inch rim wheel

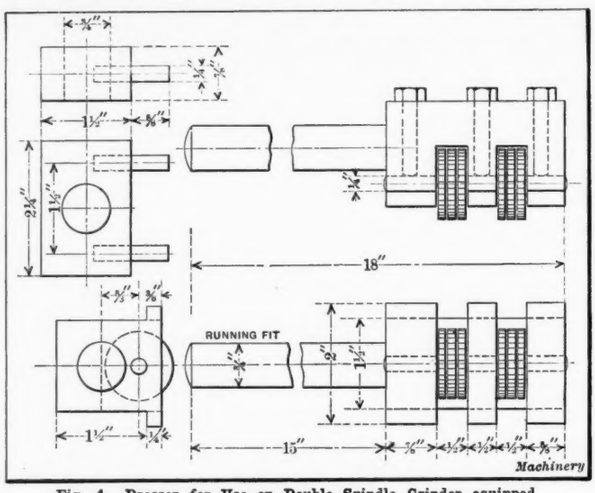



Fig. 4. Dresser for Use on Double Spindle Grinder equipped with a 1½-inch Table

is to be used for general work, a 16-grain, grade P alundum wheel is used, this wheel being a trifle harder than the one just referred to. When only cast iron or brass is to be ground, a 20-grain, grade M or N carborundum wheel will give satisfactory results. The wheels should be driven at such a speed that a peripheral speed of 6000 feet per minute is secured. As considerable power is required when grinding heavy work, good wide driving belts should be used, which give the best results when running nearly horizontal. For truing up a ring wheel, a Huntington cutter, set in a piece of ⅝ by 1½ by 3 inch machine steel and mounted on an angle-plate which can be clamped to the table, will give very satisfactory results. Such an equipment is shown in Fig. 2. The cutter is on a line with the center of the wheel and extends ½ inch beyond the inside edge of

the table. In truing a wheel with this tool, the operator feeds the cutter up to the wheel and, using the handwheel for the table traverse, passes the cutter back and forth across the wheel until the latter runs true. This wheel dressing tool should be kept on the table at all times when the nature of the work will permit so doing. If the truing tool is set ½ inch over the edge of the table and the jigs are so designed that the work extends ¾ inch over the table, the truing tool does not interfere with the use of the machine and is ready for service at an instant's notice. The wheel truing tool will be seen in Fig. 1 between the magnetic chuck used to hold the hand hole plates and the box jig seen at the right-hand end of the table. For removing glaze from the wheel, a Huntington dresser may be applied free-hand if necessary. Experience has shown that oil or tallow applied with a cloth helps to keep the wheels from glazing when grinding large malleable iron or steel parts.

Fig. 3 shows two 16-inch ring wheels with 2-inch working faces, mounted in "Perfection" ring wheel chucks on a Gardner double-head grinder. This machine has a lateral movement of one or both heads by simply engaging the rack on one end of the machine. The grinder shown in this illustration is also equipped with the Gardner sliding table attachment which has the top of the table planed off so that special fixtures are fastened to it. This combination of a double-head machine with the sliding table attachment has enlarged the field of ring wheel grinding on double-head machines, because it is now possible to grind two parallel sides on this machine and obtain absolute accuracy. For keeping the dust out of the ways on the sliding table attachment, the top and sides are covered with a piece of 16-gage iron and the front is protected by a piece of rawhide with a weight at the bottom. This has proved quite an effective means of keeping dust out of the ways. It is absolutely necessary to keep the ways clean so that the table runs the full length of its traverse without lost motion, which it will not do if the ways get worn at the front end.

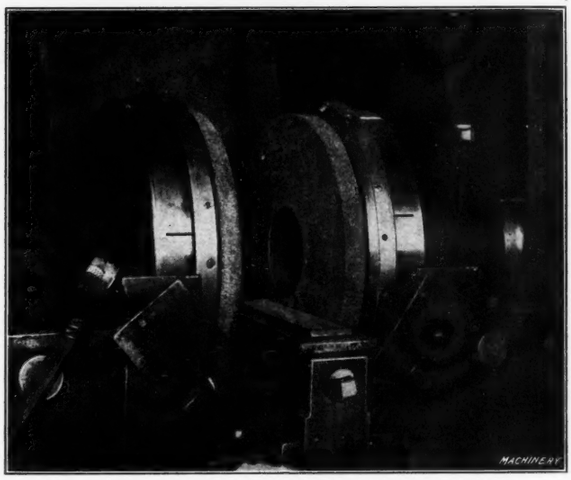



Fig. 5. Type of Dresser used Free-hand for removing Glaze from Wheel

The grinder shown in this illustration is working on malleable iron pump links and the sliding table or spring attachment is being used. One end is securely fastened between two clamps and held in place by an eccentric lever; and with the two ring wheels held in a positive position by means of the foot lever, the disk is forced between the wheels and ground to exactly the required size. When the opposite end is ground, the table is adjusted to the right position, after which the operation is conducted in the regular way. This work was formerly milled and required four minutes to finish each piece; it was found that it could be finished by grinding with equally satisfactory results and that it only required one minute per piece by this method. The wheels used for this purpose are 16 inches in diameter by 5 inches wide; the working face is 2 inches in width and the hole in the wheel 12 inches in diameter. The wheel is 24-grain, grade P or Q alundum, and runs at a peripheral speed of 5500 to 6000 feet per minute.

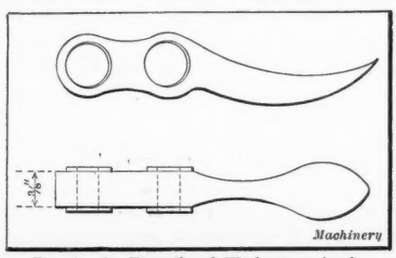



Fig. 6. An Example of Work conveniently held by Hand

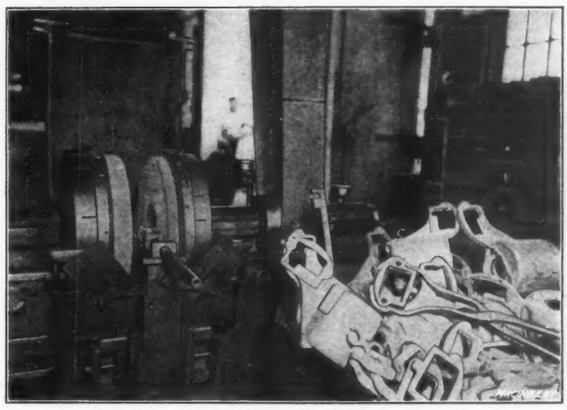


Fig. 7. A Case where holding the Work by Hand increases Operating Efficiency

The trimmer shown in Fig. 4 is used for truing the wheels of single- and double-head grinders where wide-faced, solid wheels are used, and the successful application of solid wheels on disk grinders is largely due to the perfection of this double cutter dresser. To grind a piece of work true by "floating" it up to a disk or applying it free-hand, it is essential for the wheel to have a perfect face, and this can only be secured by the use of an efficient dresser such as the one shown in this illustration. The clamping of an ordinary Huntington dresser on a geared lever feed table of a single-head machine, and rocking it across the face of a wide faced wheel, was tried but did not prove satisfactory, as it was noticed that when the cutters were in a vertical position, they cut faster than when rocked to an angle of 10 or 15 degrees. This resulted in the wheel being lower where the cutters passed over the wheel in a vertical position than at the outside and inside edges where the cutters were inclined at an angle of about 15 degrees. The single cutter emery dresser can be used for dressing a ring wheel with a two- or three-inch rim, because all work done on a narrow ring wheel is rigidly clamped in a jig or fixture and is not dependent upon whether the face of the wheel is even or has a groove 0.003 inch or more in depth at the center. The only requirement is that the wheel shaft shall not run out of truth. The shaft for the double cutter dresser should run in hardened bushings and the bushings should be kept from turning inside the cutter-head by means of ¼-inch set-screws put in back of the head. Unless this is done, the bushing will turn and the hole become worn, resulting in lost motion which must be avoided if the wheel is to be dressed quickly and accurately.

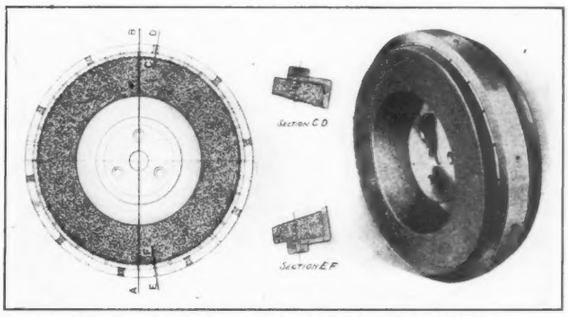



Fig. 8. The Gardner "Perfection" Ring Wheel Chuck

For truing ring wheels on a double-head machine, when the work is being ground in a fixture and a table from ½ to 3 inches in width is used between the wheels, the double cutter dresser shown in Fig. 4 can be used, although this tool was really designed for truing wider faced wheels. As usu-

ally employed, a 1½-inch table is used for a rest and the guide block is set 4 inches outside of the rim of the wheels, on the center line of the table, and with the handle passing through the guide block. The cutters are passed back and forth across the face of the wheels, at the same time adjusting the depth of cut by regulating the back stop screw, until the wheels run true. These wheels have run without truing for several hours, and an occasional use of a dresser applied free-hand to remove the scale or glaze was the only attention

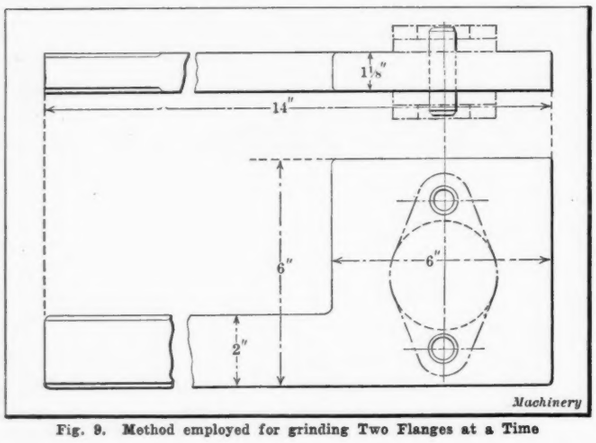



Fig. 9. Method employed for grinding Two Flanges at a Time

required. For this purpose, a Huntington cutter set in a ⅝ by 1½ by 14 inch machine steel handle, with the handle shaped as shown in Fig. 5 in order to reduce the weight, will be found very satisfactory. A dresser of this type is also used for truing wheels when the spring attachment or sliding table is used, by clamping it onto the table and proceeding the same as when using a double cutter dresser.

For grinding cast iron or brass, a 24-grain grade G+ or H carborundum wheel may be used with satisfactory results. Ring wheels should be rather harder than solid wheels for the same class of work, because when the wheels are locked and the work forced between them, the edges soon wear round, and where close limits are required the adjustment of the wheels to take up wear is not necessary at such frequent intervals. The work-table used on a double-head machine may be made in different widths so that small work such as malleable iron castings of the form shown in Fig. 6, which are to be ground on two sides to a width of ⅜ inch, can be held by hand, thus saving time that would otherwise be required to secure the work in a fixture and remove it when finished. It is sometimes more convenient to hold the work by hand, a case in point being the reservoir shown in Fig. 7, which may be conveniently handled, the operator using both hands for the purpose. For finishing work that must be held to close limits, it is best to use the machine with the left-hand head locked, having all of the movement in the right-hand head, as there is likely to be some lost movement in each head and the error due to lost movement is reduced 50 per cent by holding one of the heads stationary. The work may easily be ground within a limit of 0.003 inch when this precaution is taken.

Fig. 8 shows a ring wheel mounted in a "Perfection" ring wheel chuck. There are many designs of these chucks to be had, but some of them are of such a weight that they are very inconvenient to handle. The chuck shown in the illustration is recessed at the back to reduce its weight as far as is consistent with safety. The operation of this chuck is simple and it acts quickly. Fig. 7 shows two 16-inch carborundum ring wheels with 5½-inch working faces mounted in "Perfection" chucks which are set up on a Gardner double-head machine. A table 1½ inch in width with a guide block set four inches outside of the wheels is mounted preparatory to dressing the wheels. The valve end of the auxiliary reservoirs shown on the work bench is ground on this machine, the grinding time being three minutes. These parts were formerly finished on the shaper, by which method fifty minutes was required to finish them. The valve casing, held in the iron tongs of the work-holder, is also finished by grinding. This piece was finished on the shaper before the use of the disk grinder was adopted, and a corresponding saving of time through the change has been effected. These pieces are 5½ by 4 inches in size and are ground to a width of ½ inch; a reduction of 1/32 inch in thickness is made during the finishing operation and the work is held to a limit of 0.002 inch as regards the parallelism of the sides. The clearance of the wheels from the inside of the valve end to the body of the reservoir is only ¾ inch and when the wheels are worn down to within ½ inch of the face of the chuck, the retaining rings on the chuck will not allow the valve end to be finished next to the body. To overcome this difficulty, the chuck bodies were beveled back to within 1/16 inch of the hollow set-screws; this beveling of the rings has also made it more convenient to handle many other classes of work on the sliding table. Solid wheels used on double-head grinders stand up and wear evenly for a long time, and when it is necessary to true them up the truing can be done in about ten minutes, the method of procedure being the same as that described for ring wheels on a double-head machine. Solid wheels of this kind have been used for two days by a skillful operator without needing to be trued up with the table dresser, the occasional use of a single cutter dresser to remove the glaze being all that was required.

Fig. 5 shows a table 3 inches in width with a 2-inch guide on the top which fits in a groove in the bottom of the work-holder. This equipment is used on work finished on four or six sides, which must be kept parallel and square with each other. Such work is finished more economically in this way than on a single-head machine, grinding one side at a time. For a plant having a limited amount of work for which a single-head machine would ordinarily be used, a double-head disk grinder can be used just as economically. Connecting-rod caps and pipe flanges as large as the one shown in Fig. 9, and work of a similar kind, can be ground two at a time

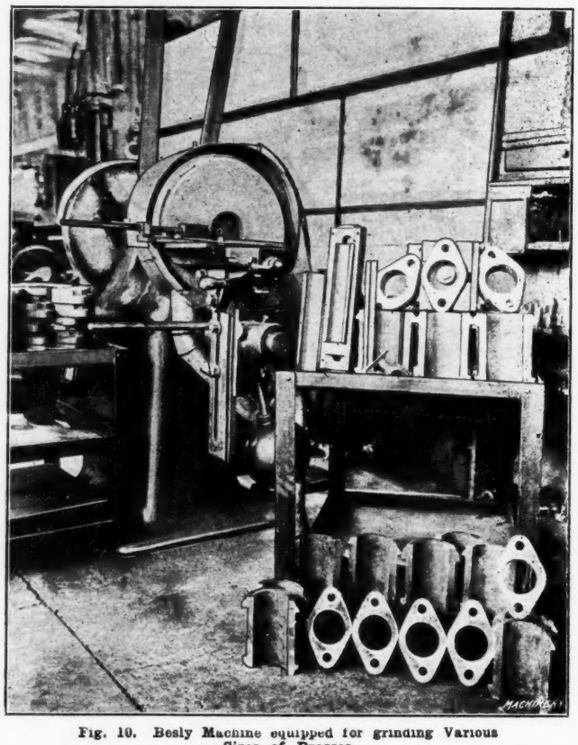


Fig. 10. Besly Machine equipped for grinding Various Sizes of Brasses

by using steel pins which fit through the holes at the ends of the flanges and secure the work together while it is being ground. The large flanges shown in Fig. 10 can be finished on the 16-inch wheels two at a time, the rate of production being fifty per hour. These machines are now equipped with a foot lever which makes it easier for the operator to handle the work, owing to the fact that both of his hands are available for this purpose. For adjusting the ½- to 3-inch stationary table or the sliding table attachment used on these machines to the right or left, two pieces of steel ⅝ by 2 by 4½

inches in size are drilled in the center to receive a ½- by 3-inch cap-screw. The slide is then drilled and tapped on each side for the ½-inch cap-screw which is slipped into the hole in the ⅝-inch plates and screwed into the slide. By loosening one of these screws and tightening the other, the lateral adjustment of the table can be made in a few moments. This will be clearly understood by referring to Fig. 7. This method will be found more satisfactory than loosening the set-screws holding the gib on the top way of the slide and then tapping the table into the required position with a lead hammer. This is especially the case when lining up a job which is ground to within 0.002 inch in positive relation to an intermediate point.

For grinding cast iron and brass on these machines, 24-grain grade M carborundum wheels are found satisfactory. For steel or malleable iron, the same grain and grade of wheels are used as were recommended for grinding this material on a single-head machine equipped with 18-inch wheels. For rough-grinding work preparatory to polishing, the double-disk machine is found far more economical than an ordinary floor grinding machine on which the work is applied to the periphery of the wheel. This is especially true in the case of grinding hexagon cast brass or cast-iron nuts of all sizes, the heads of bolts, wrenches, etc. For small brass nuts which are to be polished, a 60-grain, grade N carborundum wheel can be used, and such work can then be roughed out on a No. 120 or 150 emery wheel.

Fig. 10 shows an 18-inch, solid carborundum wheel mounted in a "Perfection" ring wheel chuck and set up on a Besly grinder. The wheel is 24-grain, grade J bond GB, and is used for grinding cast-iron and brass parts. The short bearing brasses are set with the edge projecting ¼ inch over the inside of the table; they are held in a V-block and floated up to the wheel. The short, heavy brasses are 7 inches long by 5⅝ inches wide and are finished at the rate of 130 per hour. These pieces were formerly finished on the shaper, by which method the machining time was four minutes each. The long, narrow brasses are held in a special V-block fastened to an angle-plate. These brasses are 12½ by 2⅜ inches wide and are finished at the rate of 100 per hour. On the shaper, it required five minutes to finish each brass. The

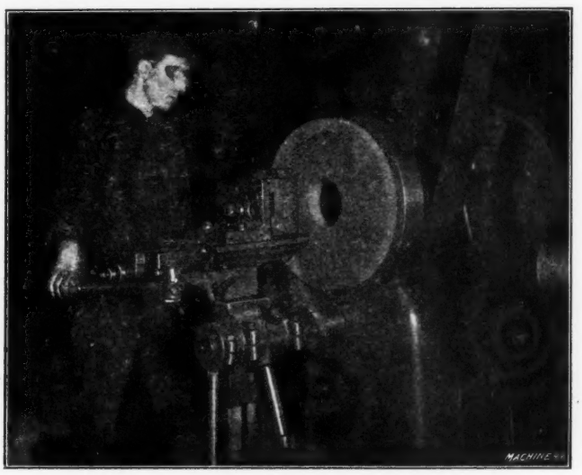


Fig. 11. Method of grinding Cast-iron Pipe Flanges shown in Fig. 10

cast-iron pipe flanges are laid in a wooden block which is cut out to conform to the shape of the work. The block is fastened in a knuckle joint fixture, and the work is then floated up to the wheel, the method of procedure being illustrated in Fig. 11. The extreme length and width of this flange is 7⅝ by 4½ inches and the pieces are ground at the rate of 75 per hour. They were formerly machined in the lathe, by which method four minutes was required to machine each piece. These pieces are merely cleaned up on the surface, *i. e.*, they are not held to close dimensions, and disk grinding should be employed for all jobs of this kind that can be finished by grinding.

For grinding steel or malleable iron parts with a surface of 2 square inches or more to be finished, a 16-grain, grade N alundum wheel should be used. For smaller areas which must be ground to within a limit of 0.003 inch or less, a 20-grain grade P wheel is suitable. The following figures show the saving effected through the use of solid wheels in place of the abrasive disks formerly employed on a certain grinding operation. The disks were 20 inches in diameter and 12 grain, such disks costing 75 cents apiece. Two and one-half disks were used up each day, which makes the cost during a period of one hundred working days $187.50. A solid wheel 18 inches in diameter by 3½ inches face width will last for one hundred days and costs $18. It will be evident from these figures that a saving of $168.50 has been effected through changing to the use of solid wheels. This represents the saving in the cost of abrasive for only one end of the machine, and an additional saving corresponding to an increase of from 10 to 20 per cent in efficiency was also effected. Furthermore, many jobs which the high cost of abrasive cloth disks made it impractical to finish on the disk grinder can now be handled in this way with a saving of from 50 to 90 per cent as compared with the cost of machining on the shaper or miller.

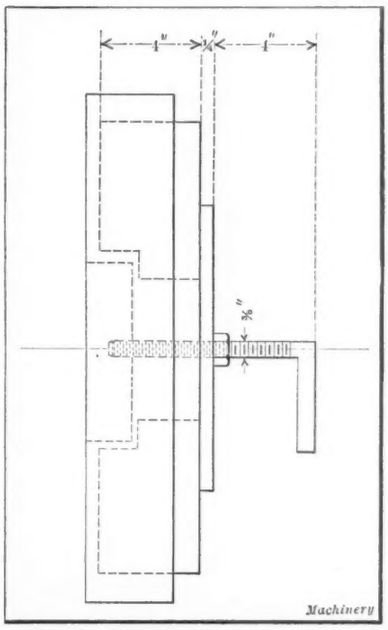



Fig. 12. Fixture for Use in Connection with Worn Wheels held in a Chuck, for holding the Wheel until Set-screws are tightened

In fitting a disk wheel into a chuck used on a single-head machine, difficulty was experienced in keeping the wheel against the back of the chuck, and when setting the wheel out after it had become worn down to the face of the chuck to be sure that the wheel rested against the "backing plugs" which are used in connection with worn down wheels. For holding wheels in place while fitting them in the chuck, the fixture shown in Fig. 12 should be used. Where wheels of different shapes or of different grains and grades have to be used, so that it is necessary to change wheels one or more times a day, wooden rings 18 inches in diameter by ½, 1 or 1½ inch wide can be used instead of the backing plugs. Their use saves time as compared with the use of the backing plugs. In this connection, it is important to note that the chuck should never be removed from the spindle of the machine while fitting a new wheel in place or setting one out that is being used. The reason is that the removal of the chuck wears out the pilot on the arbor that locates the chuck, and such wear, combined with the weight of the chuck and the wheel, and the high speed at which the wheel is driven, sets up vibration in the machine that makes good work impossible.

If trouble is experienced in getting a large disk to run true and in balance, the operator should investigate the condition of the countershaft and the lacing of the belt. If the countershaft is loose and the pulleys are out of balance, or if the lacing of the belt is bad, vibration will be set up in the machine and this is bound to show itself on the work. In the event of the wheels being too small so that they cannot be held in the chuck, they may be shimmed up with paper or cardboard; conversely, if the wheels are too large, they may be rubbed down with a piece of a worn out wheel. When wheels have been worn down to a thickness of 1 inch, which marks the limit of safety for use in a ring wheel chuck, they

can be used up on a heavy grinding stand where work is applied to the periphery of the wheel, by using a flange collar and flange with ⅛-inch rubber washers on each side of the wheel. Fig. 13 illustrates the safety collars used for this purpose.

When ordering chucks for solid disk wheels with a face width of 4 inches or more, straight backs should be specified. When the chucks are recessed in the back, the wheels have to be recessed to clear the hub of the chuck, the amount of clearance necessary for different sized wheels being given in the table. The recessed back is designed to reduce the overhang to a minimum, which may be a point worth considering on a light machine, but with the modern disk grinding machines, the straight-back chuck is preferable. A 16 by 3½ by 5 inch solid disk and an 18 by 3½ by 5 inch solid disk have been used for the past two years on one end of a Besly No. 14 single-head machine and the up-keep of the machine has not been any greater than it was when equipped with 20-inch iron disks. When an 18-inch solid disk recessed 1¼ inch deep on one side to accommodate the hub of a recessed back chuck is worn down to a thickness of 1⅜ inch, there is only ⅛ inch wall for a distance of 2½ inches out from the hole. It is not safe to run a wheel under these conditions, as a serious injury to the operator might easily result in the event of the wheel breaking. In the interest of safety, such wheels should be discarded and used up on other classes of work; they may be used for grinding small pieces or employed as ring wheels. When the wheels are first placed in a recessing chuck, backing studs 1 inch in length or a wooden ring 1 inch wide must be used to set the wheel out so that the bottom of the recess clears the hub of the chuck. Referring to the table, the diameter *A* should be held close and the wheels should be without lead bushings in the hole *C*. If it is necessary to balance them, lead should be placed on the back in the recess at *D*.

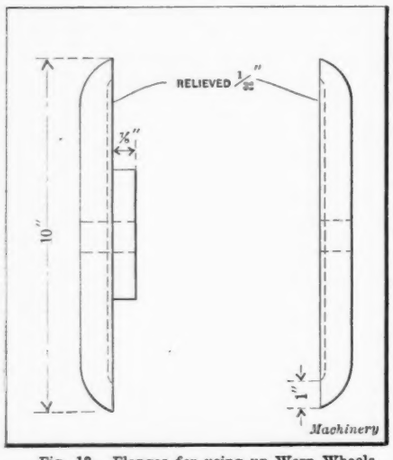
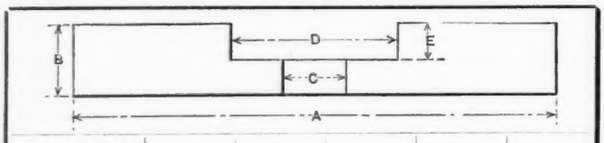



Fig. 13. Flanges for using up Worn Wheels on a Grinding Stand

DIMENSIONS IN INCHES FOR WHEELS HELD IN RECESSED CHUCKS




| Size of Chuck | A | B | C | D | E |
|---|---|---|---|---|---|
| 14 | 14 | 3½ | 4½ | 5¾ | ¾ |
| 16 | 16 | 3½ | 5 | 7 | 1 |
| 18 | 18 | 3½ | 5 | 10 | 1¼ |

Machinery

To secure a fine finish on small brass nuts or similar work, a carborundum wheel of 36 to 60 grain, grade M, will be found satisfactory. For securing a finer finish on steel, a 36 to 46 grain, alundum wheel of grade O or P can be used. Such wheels are not recommended for fast cutting; they are only suitable for those classes of work where a No. 46 grain cloth disk would give satisfactory results. Much might be said in favor of the use of solid disks for special jobs and also of the class of work-holders which are most suitable in different cases, the position of the work when applied to the wheel, and how the work is most easily brought to the required condition, but lack of space precludes the possibility of presenting detailed information on these points.

## THE RIGHT WAY OF OBTAINING FOREIGN TRADE

Many columns in our newspapers and trade journals have been filled with suggestions relating to the methods of obtaining South American trade. In nearly all of these a sound conception of the fundamental laws of commerce and trade between nations has been conspicuous by its absence. People who have not the slightest conception of political economy in its application to foreign trade rush into print with suggestions extremely one-sided in their nature. It is, therefore, refreshing to find a business man who suggests that there is a right and wrong end at which to begin the expansion of the South American trade. M. W. Mix, president of the Dodge Mfg. Co., Mishawaka, Ind., urges that buyers, rather than salesmen, should be sent to open our trade relations with South American countries. There is a plain reason for this proposal. The Latin-American countries have lost not only the markets in which they used to buy, but also the markets in which they used to sell their products. Before a credit system with this country can be established, enabling the South American republics to buy, they will require a market for the goods that they have to sell to replace the market which they had in certain European countries.

Latin-America's present need is not for salesmen asking her to buy, it is for buyers of what she has to sell. If in this country users are found for South American products—if markets are opened here for goods to replace the markets of Europe—then credit will be established here on which South America can buy goods from the United States. The problem is not merely one of rushing salesmen and samples to people ready to buy and able to pay; it is one of organizing broader trade relations and effecting an exchange of commodities.

It was aptly stated by the *Chicago Herald* that in the end all trade is barter; it is an exchange of surplus products. Many people think of trade in terms of money only and have no conception of the trade relations between nations as they actually exist. If the United States buys from South America then South America can buy from the United States. We must buy as well as sell, and in this particular case it is practically necessary for the United States to buy first in order to establish a credit for the South Americans.

A similar situation relating to the trade possibilities in Sweden for goods from the United States is voiced by our consul at Gothenburg. He intimates that there is considerable demand for American goods on the part of Swedish importers at present, but that it is impossible for them to buy on account of the fact that there is no credit established for them in the United States. To buy as he says, they must have "dollars in New York," and to establish such credit it is necessary that Sweden shall sell something to merchants in this country. Even in times of peace, gold shipments take care of but a small percentage of the trade between nations. In these troublesome times large gold shipments are out of the question, and practically all trade between nations must take the nature of an exchange of exports and imports—not directly, of course, but indirectly through our credit and banking system.

* * *

The safest way to store pig iron, says the *Travelers Standard*, is to stow it in bins, or pile it up in neat stacks. This is more costly, however, than throwing it down promiscuously in piles, and hence the safer methods are often neglected. Electro-magnetic cranes are coming into wide use for handling pig iron, and although they are very convenient, they have serious drawbacks when regarded from the safety standpoint, and their hazards should be clearly understood and carefully avoided. When the electro-magnet is used no one should be permitted to stand, walk, or work near the path followed by the magnet, because any interruption of the electric service, from the opening of a switch, the blowing of a fuse, the short-circuiting of the magnet coil, or any other cause, will instantly let the whole load drop. Sometimes, too, a pig is just barely held by the magnet, so that the least jar will break its contact and allow it to fall.

# LETTERS ON PRACTICAL SUBJECTS

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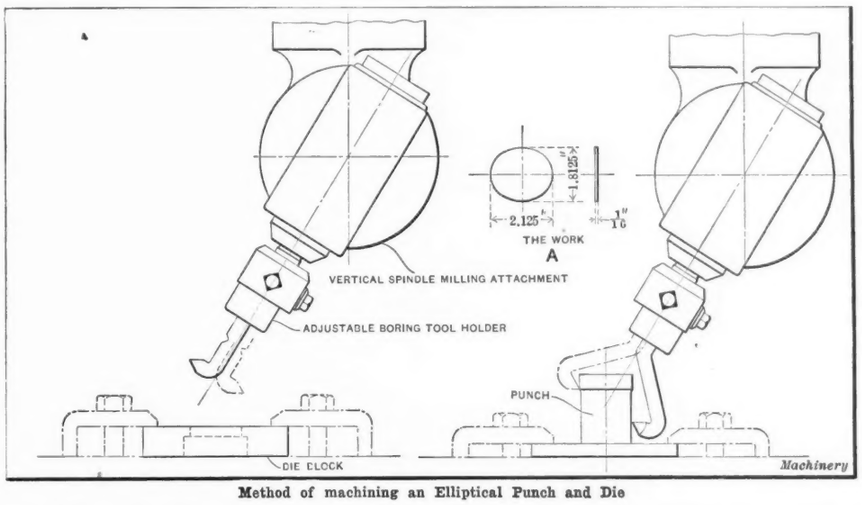
## ELLIPTICAL BORING AND TURNING

The writer once had occasion to make a blanking die for the part shown at *A*. The shape of this part is an ellipse, with a major axis of 2⅛ inches and a minor axis of 1 13/16 inch. The elliptical hole was bored in the die block by setting the vertical milling attachment at an angle with the table. The hole was first bored round, leaving stock for finishing, and was recessed on the under side, as it is impossible to bore a deep hole by this method.

The proper angle at which to set the vertical spindle was obtained by dividing the minor axis of the ellipse by the major axis, which gave the cosine of the angle, in this case 31 degrees, 28 minutes. With the spindle swung to this angle it was only necessary to feed the table of the miller up in the usual manner, the tool following a perfect ellipse. The punch was turned in the same way, using a forged tool in the vertical attachment. It is necessary to have the tools ground to a sharp V-point, as any curve on the point would present different cutting edges on opposite sides of the work, with the result that it would not generate a perfect ellipse.




Method of machining an Elliptical Punch and Die

Detroit, Mich. R. A. BLACK

## A PROBLEM IN GEARING

In presenting this article my object is principally to show how easily even the best machine designer may make serious blunders, overlook simple principles when they appear in a slightly unfamiliar form, and design a wholly inoperative mechanism. In this case not only was the designer a first-class mechanic, but so was the machinist; yet the mechanism described here was actually completed and ready for trial before the mistake was discovered. In order to perform a certain function in an automatic machine, a device was constructed embodying the scheme of gearing shown in Figs. 1 and 2.

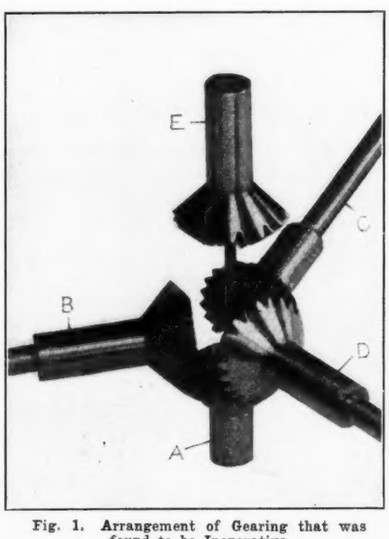



Fig. 1. Arrangement of Gearing that was found to be Inoperative

The miter gear *A* has 22 teeth and its axis is in a vertical line. The miter gears *B*, *C* and *D* are exactly like gear *A* and mesh with it. The axes of these gears, of course, lie in the same plane (horizontal) and they were at first spaced equidistant around the gear *A*, as shown in Fig. 2. At a certain period in the cycle of operations, another gear *E*, Fig. 1, which is exactly like each of the other four gears, and whose axis is in the same line as that of gear *A*, is supposed to move into mesh with gears *B*, *C*, *D* and, of course, rotate in the opposite direction to gear *A*.

When the device was tried the gear *A* meshed with and drove the gears *B*, *C*, *D*, but when gear *E* was tried it did not mesh properly with gears *B*, *C*, *D* while they were in mesh with gear *A*, but ran all right with them when gear *A* was removed. The designer was positive that the lay-out was correct and that the trouble was due to inaccurate workmanship. In his opinion the trouble might be caused by the axes of gears *B*, *C*, *D* not radiating from the apex of gear *A*, not being in the same plane, or not being spaced exactly 120 degrees apart; but most likely the fault was in the cutting of the gear teeth which were probably cut skew-wise so that while the gears *B*, *C*, *D* might run with gear *A* alone, they could not possibly run with gear *A* and *E* at the same time, as then the errors would be multiplied.

The machinist was just as positive in his assertion that the workmanship was accurate. He had a suspicion, however, that the cause of the trouble was that the gears *B*, *C*, *D* were not correctly spaced in the design. He thought that they should be spaced a whole number of teeth apart around gear *A*, instead of being 120 degrees or 7 1/3 teeth apart. How to prove this was the question. As the machine would not run, it was up to him to show why, which he did by laying out a diagram in which the gears *A* and *E* are supposed to be of infinitely large diameter so that they can be represented by racks *A* and *E*, Fig. 3. The gears *B*, *C*, *D* are represented by pinions *B*, *C*, *D*. The pinions *B* and *C* are shown a whole number of teeth (six) apart. It was readily seen that the center distance between pinions *B* and *C* could not be altered by one-third of a tooth distance. The least possible change in center distance that can be made is one-half tooth, as shown at *D*, where tooth *X* has been moved one full tooth in rack *E* and tooth *Y* has been allowed to remain in the same space in rack *A*. The number of teeth (twenty-two) in the gears could

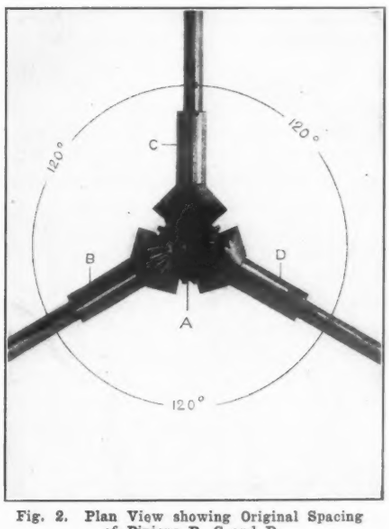



Fig. 2. Plan View showing Original Spacing of Pinions B, C and D

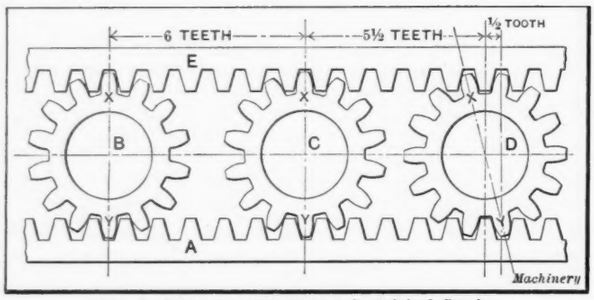



Fig. 3. Diagram showing Error in Original Spacing

not be changed, so the device was reconstructed with the correct spacing, and then it ran all right.

Brooklyn, N. Y. SAMUEL GAHAN

## THREAD MEASURING TOOL

A thread measuring tool was devised in order to eliminate the "personal equation" in measuring thread plug-gages and in comparing them with standards, as it had been found that in using thread micrometers, whether equipped with conical or ball points, measurements made by different men—or even by the same man at different times—showed variations of from 0.0001 inch to 0.0003 inch. This tool was designed to dispense with the element of "touch," using, instead, the indicator principle. It is based on two fundamental facts of trigonometry: that the axis of a cylinder held in an angular groove lies in the plane that bisects the angle, and that if the angle of the groove is 60 degrees, this axis will be at a distance from the vertex of the angle equal to the cylinder's diameter.

The body of the tool is a block *B*, Figs. 1 and 2, with a 60-degree groove, a straightedge *E*, and the slot shown in Fig. 2. *E* is so placed that if either attachment *C* or *L* is in contact with it, the axis of the attachment passes through the vertex of the 60-degree angle. To bring its axis into coincidence with that of a piece held in the V, it is necessary

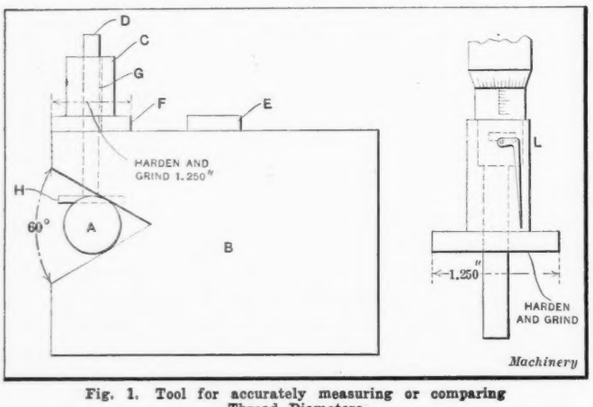



Fig. 1. Tool for accurately measuring or comparing Thread Diameters

only to insert between the attachment and the straightedge a size block of thickness equal to the diameter of the work. Fig. 2 shows the method of determining the proper location of *E*.

On the top of *B* is mounted, surface gage fashion, an indicator reading in ten-thousandths. Part *C* carries a rod *D*, which extends down through the slot in block *B* and rests upon the wire *H* laid between the threads of the work. To prevent the dropping of the wire, *D* is strongly magnetized, and to prevent the magnetism from interfering with the free movement of *D* in *C*, the former is surrounded by a brass bushing *G*. A brass grub-screw keeps *D* from falling out. Attachment *L* (see enlarged view, Fig. 1) carries a micrometer head, reading to ten-thousandths. This is fast in a bushing that is free to move upward from the shoulder on which it rests, but is held from turning by a loosely fitting screw. A piece of steel, let into the bushing, bears upon a pin in the short arm of the pointer shown. A very light spring tends to force the pointer to the left, but is prevented by the weight of the micrometer head. This attachment is so adjusted that if a 0.500-inch test bar is held in the 60-degree groove and the micrometer is turned down to make contact with the test bar and is then turned enough farther to bring the pointer to the zero mark, the micrometer will read 0.250 inch.

The wires *H* are of drill rod, hardened and ground to exact sizes, an assortment being provided to suit the different pitches of thread to be handled. A wire having a diameter equal to three-quarters or seven-eighths of the pitch works satisfactorily, but to facilitate calculations, it is well to keep to an even number of thousandths—0.120 inch, for instance, being preferable to 0.125 inch.

Now if our object is to compare a piece of threaded work with a standard, we first clamp the standard in the V, put a size block equal in thickness to the diameter of the standard between *F* and *E*, let *D* rest upon a wire laid on the standard, bring the indicator to the top of *D* and take a reading. Repeating this with the work, using, of course, the same wire,

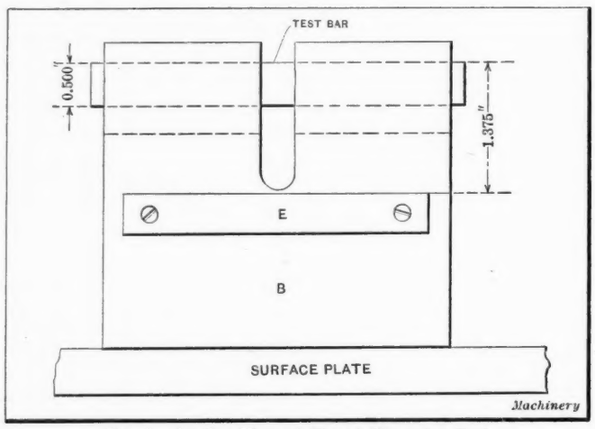



Fig. 2. Another View of Thread Measuring Tool

we know within 0.0001 inch how it compares with the standard.

If, however, we wish, not a mere comparison with an existing standard, but an actual measurement, we swing the indicator aside, and substitute attachment *L* for *C*. Subtracting from one-half the diameter of the work 0.866 × pitch, for a V-thread, or 0.7578 × pitch for U. S. standard form of thread, and adding 1½ times the diameter of the wire, gives the reading of the micrometer attachment *L*, if the size of the work is correct.

For example, if a V-thread is 1 inch diameter and has 8 threads per inch, and we use a 0.100-inch wire, the micrometer reading = 0.500 inch + 0.150 inch — 0.10825 inch = 0.54175 inch.

For a 1-inch diameter, U. S. standard thread, of ⅛ inch pitch, the reading = 0.500 inch + 0.150 inch — 0.094725 inch = 0.55527 inch.

New London, N. H. GUY H. GARDNER

## INDEXING WORK HELD IN A VISE

It is often required to machine pieces of the form shown in Fig. 1, which have a flat milled on both sides as shown at *A*, or a groove on both sides as illustrated at *B*. To handle this work in the usual manner requires an expensive set of indexing centers which are in general demand in the shop, and the following outlines a method by which work of this kind may be handled equally well in a vise equipped with a dog for indexing the work, as illustrated in Fig. 2. The use of a vise attachment of this

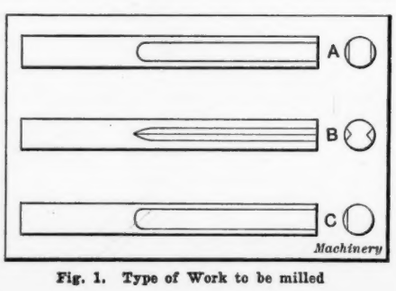



Fig. 1. Type of Work to be milled

kind does away with the necessity of tying up an expensive dividing head for handling the work, and it also enables such work to be handled satisfactorily in small shops in which a dividing head is not included in the equipment.

To mill these flats or grooves on the opposite sides of a piece of work, a pair of auxiliary jaws *A* and *B* are provided for the vise. Referring to Fig. 2 it will be seen that the jaw *A* is slotted at *X* to receive the tail of the dog *C* which is secured to the end of the work in the usual way. A detail of the dog is also shown in Fig. 2 where the provision of the set-screw *D* and shoe *E* for securing the dog to the work is clearly shown. It will be seen that the dog has two tails. In starting to mill the piece of work, the dog is secured in place on the work and set up in the vise with one of the tails entering the slot *X*. The first cut is then taken, which leaves the work as shown at *C* in Fig. 1. After completing the first cut, the work is taken out of the vise and turned over so that it may be replaced with the other tail of the dog

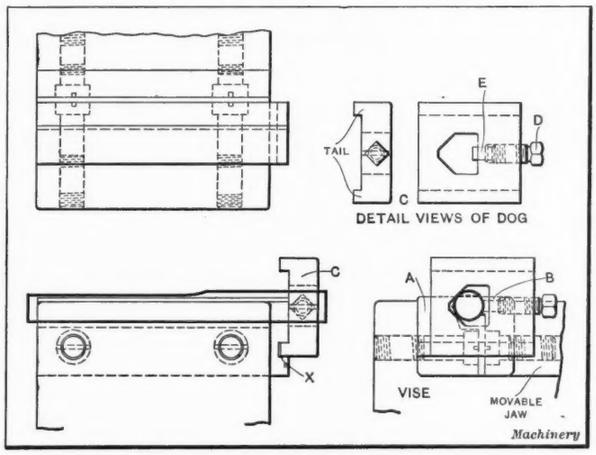



Fig. 2. Method of using Auxiliary Vise Jaws with Dog for indexing

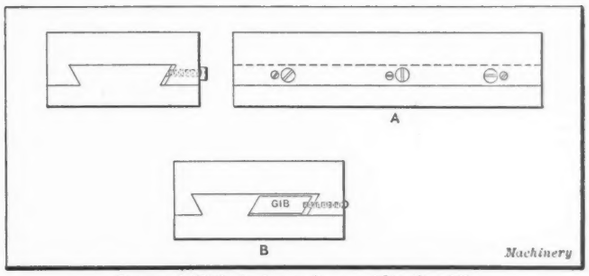
in the slot *X*. The vise is then tightened up and the second cut taken, which completes the milling operation.

F. SERVER

## ADJUSTING GIBS

The vertical slide of the tool-block in our school shaper was constantly getting out of adjustment, being either so tight in some positions that it could scarcely be moved, or so loose as to be quite useless for its purpose. This state of things was no doubt partly owing to its being constantly used by boys who are fond of adjusting things, usually in the wrong place, but probably more often to the way the gib was set up. This gib, as shown in the accompanying illustration, is a steel strip ¾ inch wide by 3/16 inch thick, and is set up by three screws which seat in depressions about 1/16 inch deep. The screws are an easy fit in the block and require very little to move them either way with the results above mentioned.

The remedy I applied, which has proved quite effective, was to drill holes close to each screw, as shown at *A*, and insert screws that are threaded into the gib and have clearance in the block. These screws hold the gib tightly against the points of the set-up screws and prevent any accidental change



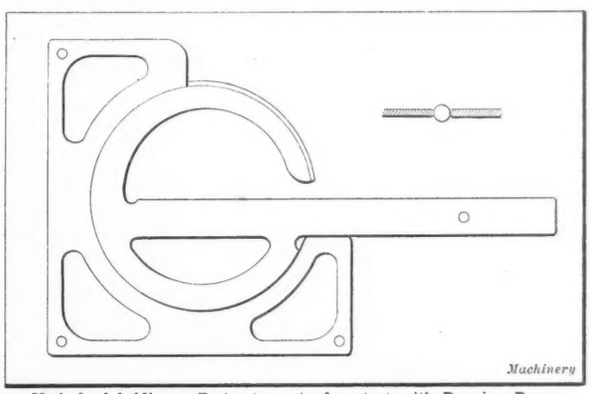

Improved Method of securing an Adjusting Gib

of adjustment. I have since applied this method to similar gibs in various other slides with equally good results. The above-mentioned gib is unusually thin and flexible, too much so, in my opinion, for satisfactory work. At the same time it is easily seen that the thinner the gib and the more closely it fits its recess, requiring the least possible overhang of the set-up screws, the better. This may be shown by giving the gib an exaggerated thickness as at *B*. Any vertical pressure applied upward will have a far greater toggle joint bursting effect on the slide than in the case where the thin gib is used.

Christchurch, New Zealand. JOHN PEDDIE

## PROTRACTOR BALL BEARINGS

In a drafting-room where I was once employed, several of the draftsmen owned Brown & Sharpe protractors. After experimenting with one of these instruments, we made the change shown in the accompanying illustration and found that it added materially to the efficiency of the tools. This change consisted of inserting regular ⅛-inch steel balls in the protractor in order to lift it from the surface of the paper. Fitted in this way, the protractor slides much easier and does



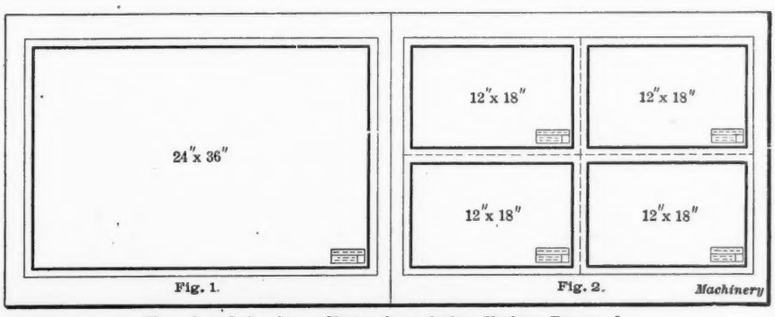

Method of holding a Protractor out of contact with Drawing Paper

not soil the paper; it is also easier to pick up, as the balls lift the instrument sufficiently to enable one to get hold of it.

St. Louis, Mo. F. E. PETTERSSON

## COVER SHEETS FOR TRACINGS

Sometimes it is desirable to make several small drawings or a number of details on one large sheet of tracing cloth, so that the blueprints may either be used as one large sheet




Figs. 1 and 2. Cover Sheets for printing Various Forms of Borders on Blueprints

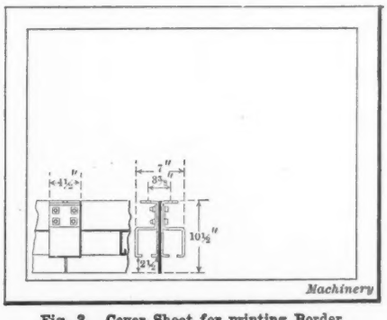



Fig. 3. Cover Sheet for printing Border and Detail on Blueprint

or cut up into several smaller ones. For large prints, a single border line around the outside of the entire sheet is preferable to having separate border lines around each detail. This is particularly true when the blueprint is used for advertising or show purposes; but if the single border line is drawn around the outside of the large tracing and the blueprint is cut up into smaller sheets, these small sheets will only have border lines on one or two sides, and this detracts from their appearance.

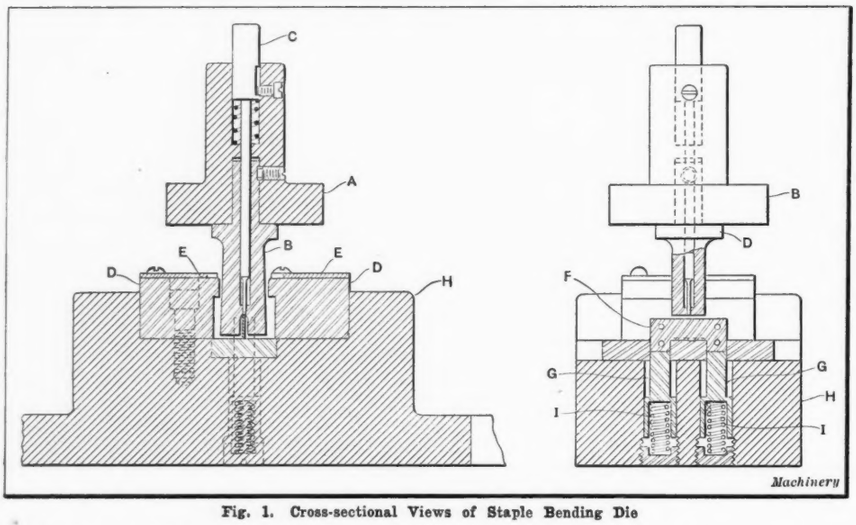



Fig. 1. Cross-sectional Views of Staple Bending Die

Such cases could be handled by making two tracings, but a much cheaper method, and one which is perfectly satisfactory, is to omit the border line from the tracing entirely and then prepare separate sheets of thin tracing paper of the same size as the original tracing, drawing the different border lines on these sheets. These sheets—which have been aptly called "cover sheets"—are fastened over the tracing with small wire paper clips to hold them in place when printing. A slightly longer exposure is required, but if a thin, transparent tracing paper is used the additional time is not excessive. Fig. 1 shows the cover sheet for a standard 24 by 36 inch drawing. The blueprints from this tracing are used largely in installation work and so arranged that they can be cut into four sheets 12 by 18 inches in size, which are bound with other prints of the same size for distribution among architects and engineers. When printing these small sheets, the cover sheet shown in Fig. 2 is used, the dotted lines in this illustration marking the trimming lines. Each of the small blueprints is given a title and drawing number.

Another use for the cover sheet is found in cases where some special name or address is desired on the blueprint, as, for instance, the name of a jobber or the address of some particular branch office. This additional lettering can be done on the cover sheet and the sheet fastened to the tracing for printing. In this way, the standard drawing is not interfered with, yet the blueprint has the appearance of having been prepared from a tracing made especially for the job. The patchwork effect resulting from other methods commonly used is avoided in this way. Still another use for cover sheets is found in cases where a special drawing is required for each job, but where some of the details on each sheet are standard. These standard details can be drawn on cover sheets and only the special parts need then be drawn on the regular tracing for each job. This saves a large amount of time without sacrificing the completeness of the drawing, the same cover being used for all of the jobs. An illustration of such a cover sheet is shown in Fig. 3. A fourth use of cover sheets consists of their application in blotting out certain figures or words on a tracing, which it is desired to eliminate from the blueprint. To accomplish this a neatly inked-in place is drawn on the cover sheet in the proper place to cover the words or figures that it is required to eliminate. To make a neat job it must be understood that the cover sheet must be the full size of the tracing; otherwise a difference in the color of the blueprint at different places will be noticeable, due to the difference in the thickness of the tracings through which the light must penetrate. The cost of these cover sheets is usually very small, and the time required to produce them almost negligible.

Aurora, Ill. E. J. G. PHILLIPS

## STAPLE BENDING DIE

We had an order for a large number of staples that were to be made of 0.025-inch sheet steel, and to provide for handling this work the punch and die which forms the subject of this article was designed. The way in which this tool operates will be best understood by first referring to the cross-sectional views shown in Fig. 1. The cast-iron punch-holder *A* carries the tool-steel punch *B*, which has ejector bar *C* running through its center. The outside bending dies *D* are provided with nests *E* for locating the blank in the required position preparatory to bending. The staples are bent over the inside former *F*, which is riveted to the tool-steel pins *G*, the pins *G* being a sliding fit in the die shoe *H*.

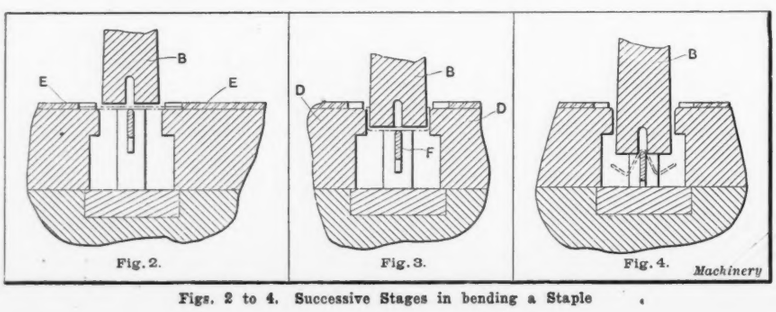
Figs. 2, 3 and 4 illustrate steps in the downward stroke of the punch *B*. In Fig. 2 the blank is shown in position in the nest *E* ready for the punch to descend upon it. Fig. 3 shows the punch after it has carried the blank down between the side bending dies *D* and brought it into contact with the inside former *F*. In Fig. 4 the punch has descended a little further, with the result that the blank is partially bent over the former. At the conclusion of the downward stroke, the two sides of the staple will be bent into close contact with the former. This is the position shown in Fig. 1.

On the upward stroke of the punch the inside former *F* rises with the punch until it is flush with the top surface of the die, this movement being actuated by the springs *I* that act against the lower side of the pins *G* on which the former *F* is mounted. The staple is held in the punch *B* until the punch has almost reached the top of its stroke. At this point a knock-out bar on the punch press strikes the ejector bar *C* and ejects the staple from the punch. The press is inclined so that the work drops clear of the die and leaves the latter ready for the next operation.

Harrison, N. J. A. J. O'MALLEY

## KNOCK-OUT FOR A PUNCH PRESS

The accompanying illustration, showing a mechanically operated knockout for the punch press, will require little explanation to make the design of this equipment clear to any mechanic. This mechanism was designed by F. Green, tool-room foreman of the Bausch & Lomb Optical Co., Rochester, N. Y., and has




Figs. 2 to 4. Successive Stages in bending a Staple

been in successful operation in the punch press department of that company's factory for the last three years. It operates more satisfactorily than a rubber bumper—especially for brass forging dies and small re-draw dies, and is less expensive.

Fig. 1 shows the attachment in place on a punch press. Referring to this illustration, *A* is a collar which is bored out to fit over the projecting end of the crankshaft to which it is fastened by means of two bolts shown at *L* in Fig. 4. Adjustment of the length of the stroke is provided by means of a T-slot in which the crank-pin *K* is secured, and the knockout can be timed to suit the requirements of the work on which the press is engaged by loosening bolts *L*, Fig. 4, and turning collar *A* to the right or left with relation to the crankshaft. The hubs *B* at each end of the connecting-rod *C* are alike, except that one hub is threaded right hand and the other left. The connecting-rod *C* has a flat on it which can be engaged by a wrench, and by turning the rod, a very fine adjustment of the knockout is secured. Further adjustment may be made by using different sizes of washers *J* and knockout pins *I*.

In Fig. 3, it will be seen that the collars *E* support bearings in which the shaft *F* turns. These collars have four corrugations are milled on the inside of collar *A* and the brake hub to prevent the collar from slipping.

Rochester, N. Y. CARL M. WEBER

## A SANITARY SHOP SINK

There are many shops where no particular attention is given to the provision of sanitary equipment for the use of employes in washing up after their day's work. Often half a dozen men may be seen washing in a single bowl, and little discussion is necessary to emphasize the dangers of such a practice. The importance of the provision of proper equipment for this purpose is becoming generally realized, and there are now many shops where soap and towels, and strictly sanitary equipment are provided. The apparatus which forms the subject of this article is used in the machine shops of the Leedy Mfg. Co., Indianapolis, Ind., and was installed by the company's superintendent, Mr. Charles B. Wanamaker. A constant stream of warm running water is provided, which is ample for the purpose without requiring an unnecessary amount of water to be used.

The unit accommodates twelve men at a time and is made

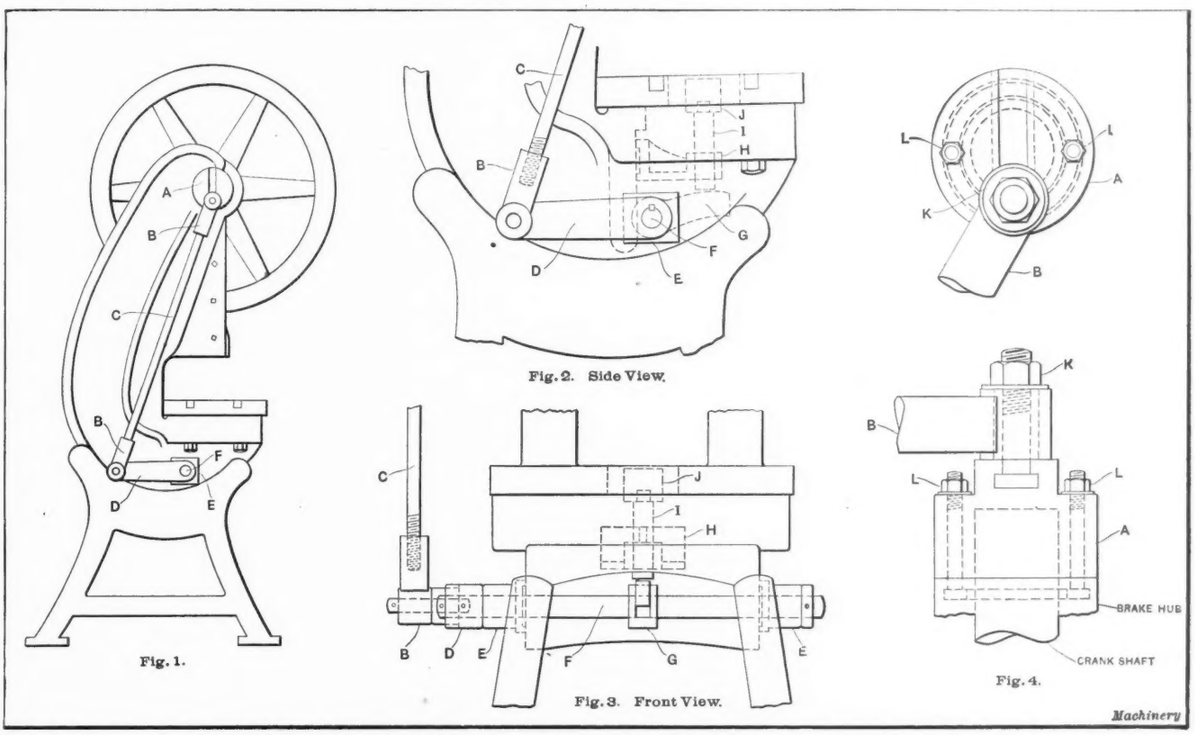



Fig. 1. Fig. 2. Side View. Fig. 3. Front View. Fig. 4.

**Figs. 1 to 4. Power Press equipped with a Mechanical Knockout and Views showing Details of Design**

short legs cast on them, it being possible to file the legs to compensate for irregularities in the frame of the punch press on which the attachment is to be applied. The collars are fastened to the bed of the press by four half-inch cap-screws. The crank *D* is keyed to the shaft *F* and the same method is used in securing the cam *G* in place. The bracket *H* has four short legs cast on it so that it may be fitted to the rough bed casting and fastened by two cap-screws. The hole in this bracket is bored large enough so that the knockout pin *I* is a sliding fit in it.

The method of operation of this attachment is as follows: When the ram of the press is in the upper position, the collar *A* is set with the slot vertical. The hub *B* is next fastened to the lower end of the slot by means of the stud shown at *K* in Fig. 4. On the downward stroke of the ram, the collar *A* makes one-half revolution, thus raising the connecting-rod *C* and crank *D*. The cam *G* turns and lowers the knockout pin *I* and collar *J*. Then when the ram commences its up stroke, the crankshaft completes the revolution, pushing down the connecting-rod *C* and the crank *D*, and raising the pin *I* and collar *J* through the action of the cam *G*. In this way, the work is ejected from the die. In some cases of thin boards supported on legs 2 by 3 inches in size. The boards *A* and *B* and the trough *C* are covered with zinc. The boards *A* and *B* were provided for supporting individual wash basins which were originally used. It was found more convenient, however, for the men to wash directly under the small jets of water. These jets *D* are made of ⅛-inch pipes tapped into the main supply pipe. As the stands for the basins are no longer required, it is intended to make the next unit by substituting curved sheet metal guards in place of the stands *A* and *B*. These guards will absolutely prevent water from being splashed onto the floor or on the workmen's clothing, and would provide better drainage back into the trough.

The hot water is obtained by allowing steam and cold water to enter opposite ends of the mixing pipe *E*. By properly adjusting the water and steam valves, a steady flow of water of any required temperature may be obtained. Fig. 2 shows a cross-sectional view of the water heating arrangement, from which the construction will be better understood. Referring to this illustration, it will be seen that the steam enters into the larger pipe which is the heater, while the water is admitted through a smaller perforated pipe. It

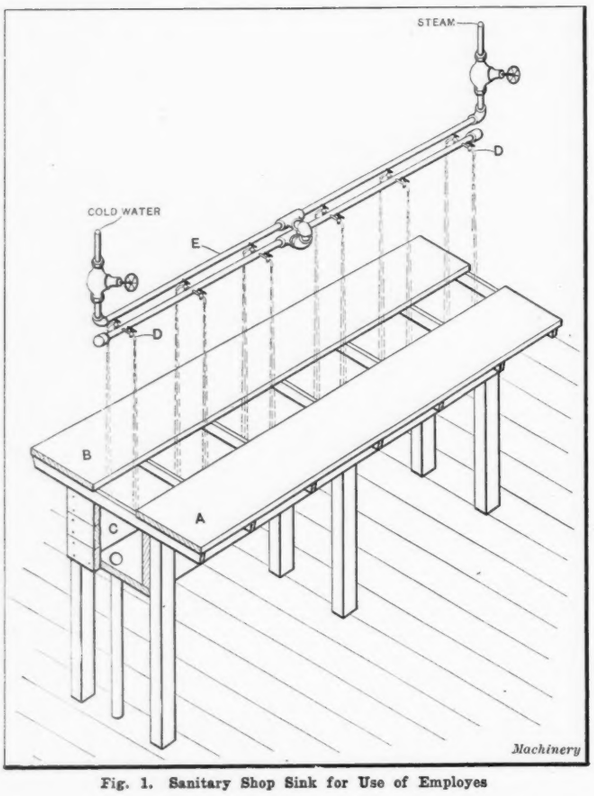



Fig. 1. Sanitary Shop Sink for Use of Employes

will be evident that the steam cannot be discharged into a pocket of cold water and result in the disagreeable condition known as "water hammer" which is one of the annoying features of many steam installations. The chief advan-

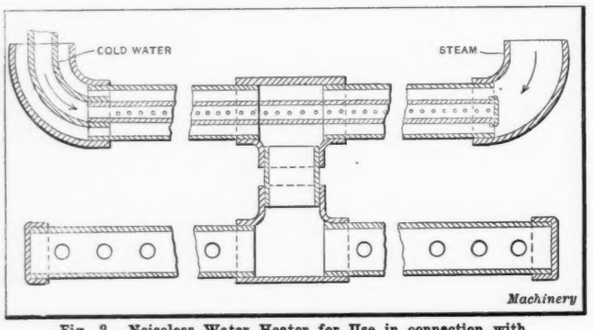



Fig. 2. Noiseless Water Heater for Use in connection with Sanitary Sink

tage of this wash-up equipment is that each man is bound to use a fresh supply of water so that infection is a practical impossibility.

Indianapolis, Ind. JAMES F. HOBART

## AUTOMATIC STOP FOR BLANKING DIES

This stop is intended for use on small blanking dies in which the stock is fed through in a long strip. The usual form of stop employed for this purpose is shown in Fig. 1 and reference to this illustration will show that it consists of a pin with one side beveled, the pin being held in contact with the work by means of a spring. To operate this stop, it is necessary to push the stock ahead and then draw it back so that the edge of the hole from which a piece was blanked in the preceding operation, comes into contact with the stop pin. It will be evident from this that a double movement is required, *i. e.*, to first push the stock ahead more than the required distance and then pull it back into contact with the stop. The advantage of the mechanism shown in Fig. 2, which forms the subject of the present article, is that the operator is only required to push the stock ahead until it engages the stop, thus doing away with the double movement.

Referring to Fig. 2, it will be seen that this improved stop mechanism consists of a trigger *A* which is pivoted on the pin *B*. The trigger works in a tapered slot in the stripper plate which allows it a sidewise movement of about 1/32 inch. A helical spring *C* pulls the point of the trigger down and tends to hold it on the side of the slot nearest to the advancing stock. A trip screw *D* is screwed into the upper member of the sub-press die directly over the trigger, and is so adjusted that it will cause the point of the trigger to be raised as soon as the punch has started operating on the stock. The method by which this mechanism operates is as follows: When the stock is pushed forward against the trigger, the latter is moved over to the far side of the tapered slot and the stop locates the stock in the required position for punching. As soon as the punch engages the stock, the trip screw *D* strikes the trigger and raises this point out of contact with the stock. As soon as the point of the trigger is out of the hole in the stock, the spring *C* pulls it to the opposite side of the tapered slot so that when the punch rises and the trigger is allowed to drop, the stop comes down on top of the stock instead of in the hole produced by the blanking operation. Consequently, the stock can be pushed forward until the stop drops into the next hole and the movement of the stock is then continued to the position for the next punching operation. The point of the trigger is beveled at the back to provide for withdrawing the stock if necessary. The sliding stop *E* is placed in the stripper plate to locate the end of the stock in the proper position for the first operation with progressive blanking dies.

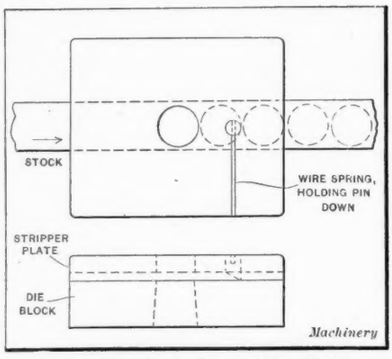



Fig. 1. Stop Mechanism requiring Double Movement to locate Stock

Detroit, Mich. R. A. BLACK

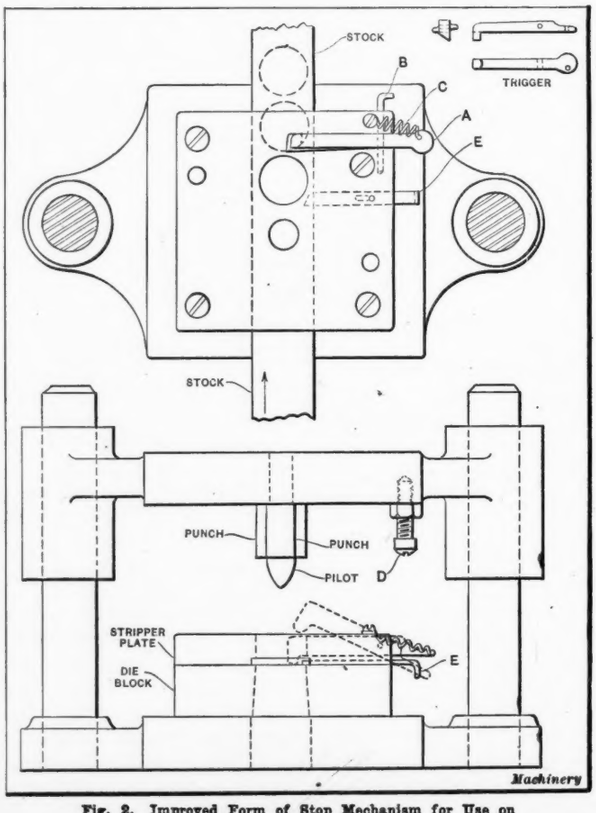



Fig. 2. Improved Form of Stop Mechanism for Use on Progressive Blanking Dies

## A VISE DRILLING JIG

The accompanying illustration Fig. 1 shows a quick way for drilling and milling an elongated hole in a piece of work where the limit of accuracy required is not less than ± 0.003 inch. The writer having several hundred shafts *A*, Fig. 2, to machine, realized that after the drilling operation, to

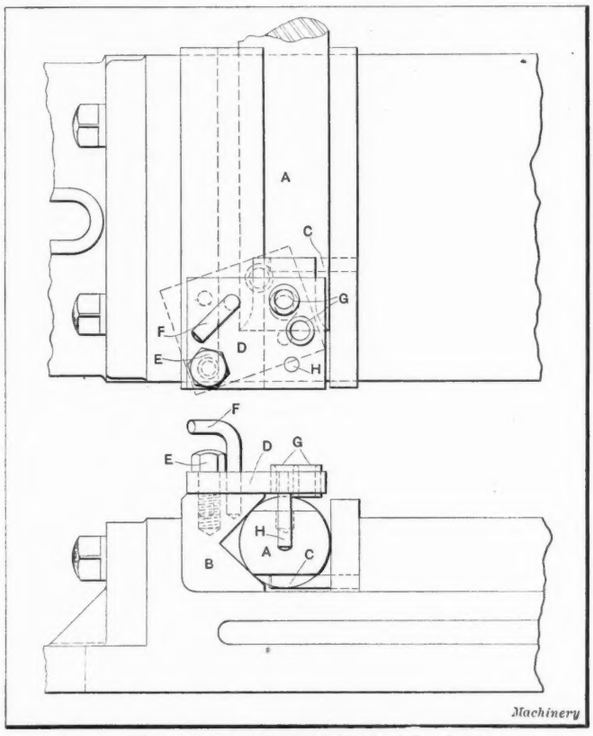



Fig. 1. Vise Drill Jig with Swiveling Leaf for forming an Oblong Hole

elongate the hole *a* with an end mill in a milling machine and produce the work cheaply and quickly would result in considerable tool breakage, besides handling the work twice. So the following method was employed with success.

A flanged milling machine vise was fitted with a special jaw having a V groove cut lengthwise, as shown at *B*, Fig. 1. Pin *C* was put into a soft jaw on the movable slide of the vise and located so the milled surface of shaft *A* would rest on the upper surface of the pin and hold the shaft level for drilling. Bushing plate *D* was next put on and held in place by a cap-screw *E*. Bushing plate *D* was then laid out and drilled and reamed in position for the locating pin *F* and the drill and counterbore bushings *G*. The stop-pin *H* was located in the bushing plate *D* to insure getting the right location of the drilled hole from the end of the shaft *A*.

After the hole was drilled the locating pin *F* was pulled out and the plate *D* swung around from the first position, as shown by the dotted lines, to the second position, and pin

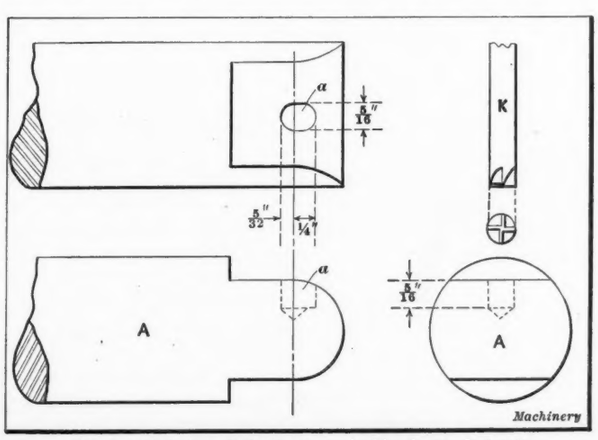



Fig. 2. Work for which Jig shown in Fig. 1 was designed

*F* was inserted in another hole. Each hole for pin *F* was pin *F* was inserted in another hole. Each hole for pin *F* was located so as to bring the bushing plate *D* into the proper positions for drilling and counterboring. The special counterbore or mill *K*, Fig. 2, was then used through the bushing *G* to elongate the hole to the proper size and depth. This counterbore was made from drill rod of the same diameter as the width of the elongated slot in the shaft. Four teeth were cut in the end and it was then hardened and tempered. This made a cheap and efficient tool.

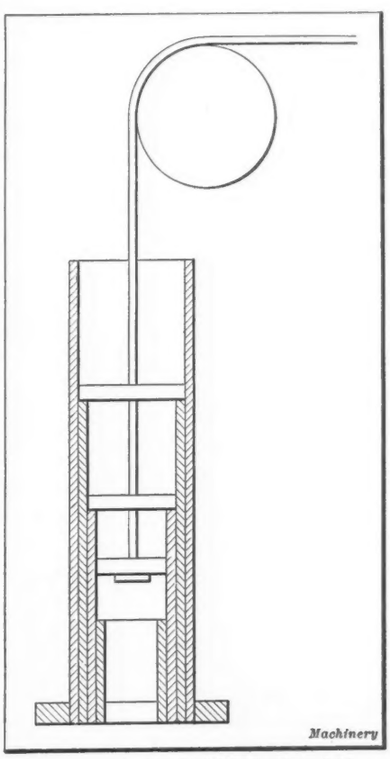
After the shaft *A* was properly drilled and counterbored, it was removed from the vise, and the bushing plate *D* swung back into the drilling position; this also brings the stop-pin *H* into position for locating the next shaft. Another shaft is now put into the vise against the stop-pin and the previous operations are repeated.

This device has been used with new bushing plates to suit many different kinds of work. For drilling and tapping, when a tapping chuck is used or on a drill press that has a reversible spindle, it will be found to be a very handy tool. After the tap hole is drilled in the work, pin *F* is pulled out and bushing plate *D* can be swung out of the way.

Providence, R. I. EDWIN C. FULLER

## A VARIABLE COUNTERWEIGHT

In designing a certain automatic machine the problem arose of producing a counterweight which would decrease in magnitude as the weight approached the floor. The desired result was obtained by means of a simple device which is illustrated diagrammatically in the accompanying illustration. It will be seen that it consists of a scale pan which holds a series of weights. These weights are circular disks which are all of a standard thickness, but of different diameters; they are placed on the scale pan so that the weight of smallest diameter is at the bottom and the largest weight at the top. The weights are hung in a guide which is made up of pieces of pipe with internal diameters corresponding to the outside diameters of the weights that are used. These pieces of pipe are cut in varying lengths and set up with the longest pipe—which is also of largest diameter—on the outside, and running down to the smallest pipe which is of the smallest diameter, on the inside.




Arrangement of a Variable Counterweight

When this counterweight is in operation, the scale pan is so hung that its center coincides with the center line of the guide. When the counterweight descends far enough to reach the end of the first section of pipe in the guide, the largest counterweight is lifted from the pan. Subsequent weights are lifted as each length of pipe is reached, the operation continuing until all of the weights have been removed. If it is desired to decrease the load on the scale pan by equal increments, the weights may be made of varying thicknesses so that all will be of equal magnitude.

Owego, N. Y. SIDNEY K. EASTWOOD

# SHOP AND DRAFTING-ROOM KINKS

INGENIOUS MEANS AND SHORT CUTS FOR SAVING LABOR AND MATERIALS

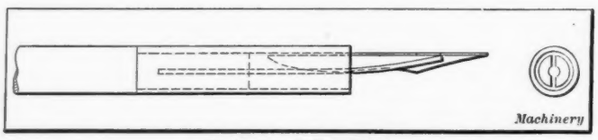
## IMPROVED FILE CLEANING METHOD

In MACHINERY for June the writer noticed an article entitled "Method of Cleaning Files." In the method described copper was employed as the cleaning element. The writer has found, from experience, that copper is fairly good for this purpose, but that sheet-fiber is much better. Another improvement is to cut the fiber into a disk about 6 inches in diameter and mount it on an ordinary emery wheel stand. When the file to be cleaned is held against this revolving disk or fiber it will be cleaned much quicker and better than would be possible by hand, or by the copper method. Fiber ¼ inch thick is best suited for this purpose.

East Orange, N. J. G. N. GARRISON

## AN IMPROVED PEN POINT

Those who have facilities for making blueprint copies of drawings frequently find it convenient to use the same method for producing duplicates of bills of material and many similar documents. Some use the typewriter for making the original copy and get fairly good results in this way, but the best blueprints are only obtainable where India ink is employed. To improve a pen point for this purpose, a small round wire may be inserted in the wooden center of

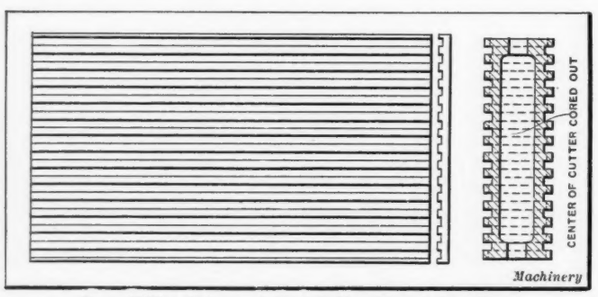



An Improved Pen Point

the pen holder with the end extending out just far enough to reach the under side of the pen at about ¼ inch from the point. With such a pen, India ink will flow freely and evenly. The arrangement is clearly shown in the illustration. A piece of German silver wire is best for this purpose, although a satisfactory substitute may be obtained by straightening out an ordinary paper clip and cutting off a piece of the required length. It is not claimed that this is a new idea, but the writer believes there are many who have not heard of it and that it may prove valuable to readers of MACHINERY. R. J. D.

## A BRASS MILLING CUTTER FOR HARD RUBBER

We have quantities of hard rubber plates ⅝ inch thick by 14 inches wide by 24 inches long, that have fourteen grooves ½ inch wide by 1/16 inch deep to be milled in them. These grooves are cut lengthwise on one side of the plate, as shown in the accompanying illustration. The cost of making a gang mill and keeping it sharp was rather high, and after experi-




Brass Milling Cutter and Hard Rubber Piece to be milled

menting we found that a cutter made of hard brass stands up well. Such a cutter does not last as long as a steel cutter would, but when it gets a little dull it can be sharpened with a file without the necessity of grinding. The formula for the brass from which this cutter was made is as follows:

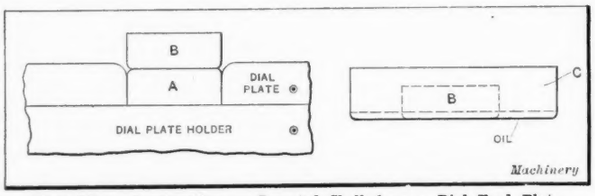
| | | | |
|---|---|---|---|
| Copper | 78 per cent | Lead | 5 per cent |
| Tin | 12 per cent | Zinc | 5 per cent |

Add a stick of phosphorus and stir the metal well before pulling the pot from the furnace.

Swissvale, Pa. WILLIAM MÜRSCH

## A DIAL PRESS KINK

The following describes a little kink that the operators in our dial press department make use of, and although it is not exactly new it will doubtless prove useful to those who are not familiar with it. In handling shells in a dial press,



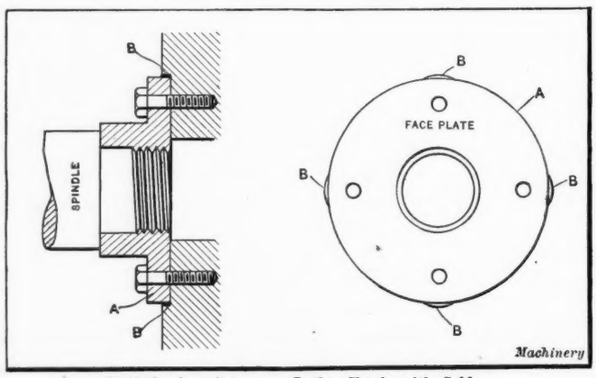

Easy Way of extracting an Inverted Shell from a Dial Feed Plate

it sometimes happens that the operator puts one in the dial the wrong way, *i. e.*, bottom side up, as shown at *A*. This shell can be removed in less time than it takes to tell about it, by placing the oiled bottom of a second shell *B* on top of the shell *A*. The application of a slight pressure causes the shells to stick together and it is then an easy matter to lift out the shell *A*. This method is far better than one which the writer has often seen used where a "picker" is jammed into the bottom of the shell *A* to remove it. This obviously destroys the shell for further use. By way of conclusion, it may be mentioned that the shell *B* is kept in a larger shell *C* which contains just enough oil to keep the bottom of the shell *B* covered at all times. This shell is kept within reach of the operator so that it is always ready for immediate use.

MIDDLE WEST

## TRUING UP A LATHE CHUCK

A lathe chuck that runs out of true may be brought back into condition to produce accurate results by the following method: After the threaded chuck faceplate has been thor-




Method of truing up a Lathe Chuck with Solder

oughly cleaned, a light cut is taken over the circumferential surface of faceplate *A*. Three or four spots of solder *B* are then applied at equal distances apart around *A*, after which these spots are turned off to fit accurately into the recessed portion of the chuck, while the faceplate is screwed onto the lathe spindle. These solder spots *B* are merely relied upon to locate the chuck in the required position, after which the screws are tightened to hold it in place.

Wollaston, Mass. GEORGE L. COLBURN

* * *

The oxy-hydrogen blow-pipe was invented early in the last century by an American, Robert Hare, at the age of twenty.

# HOW AND WHY

QUESTIONS ON PRACTICAL SUBJECTS OF GENERAL INTEREST

## TO PREVENT GUMMING OF MACHINES BY MIXTURE OF STARCH AND OIL

H. W. D.—Where I am employed, there are a number of automatic wrapping machines which give much trouble by becoming stuck. Considerable starch is used on the product wrapped, and this falls on the working parts of the machine, absorbs the oil and forms a hard and gummy coating. The machines are so constructed that it is impossible to shield the working parts. We are using machine oil as a lubricant, but have tried gasoline, and machine oil mixed with kerosene, and found that they made the machines stick worse. When the machines become stuck, we use soda water to loosen them and then apply machine oil.

A.—Perhaps deflocculated graphite in one of the several forms available could be used successfully. Suggestions from the readers are invited.

## ECCENTRIC-OVAL GEARING FOR QUICK-RETURN MOTION

G. H. B.—I was recently called upon to design a set of gears of the form illustrated in Fig. 2, and was unable to carry the work through methodically. Finally, I arrived at as accurate a solution of the problem as was possible by a purely cut-and-try method. The gearing in question was for the drive of a slotting machine and was required to give a ratio between the quick-return speed and the cutting speed of about 1.8 to 1. During the cutting stroke, the 15-tooth pinion is in mesh with the half spur gear *A*, and must be so designed that as soon as a cutting stroke is finished, the 22-tooth eccentric pinion comes into mesh with the elliptic segment gear *B*. The number of teeth in the elliptic segment gear is the same as in the pinion which meshes with it, *i. e.*, 22 teeth. My chief difficulty lay in determining the required shape for the elliptic segment gear *B*. Any information in regard to the solution of this problem would be greatly appreciated.

Answered by Frank B. Smith

On all shapers, slotters and other machines of like nature, it is desirable to have a slow, strong, even stroke on the forward movement of the tool with a quick return to the starting position after finishing the cut. To accomplish this many inventors have spent much time and energy in producing various devices, most of which have more or less merit. But in nearly all of them there is one radical fault, which is that while a slow advance with a quick return is given to the tool, the cutting stroke is not made at a uniform speed but begins with a gradually retarded motion, and then, in the last half of the stroke, the speed begins to accelerate again. This change, while hardly noticeable to the casual observer, puts an uneven strain on the cutting tool, causing it to spring more at one point than another, which results in a cut of varying depth and chips of unequal thickness. This fault, while of no great importance where the cut is short, makes a material difference on cuts of greater length when very close work is desired. It was to overcome this defect and to produce a machine with an absolutely uniform motion during the entire cutting stroke, that the novel combination of oval-eccentric and spur gearing shown in Fig. 1 was designed.

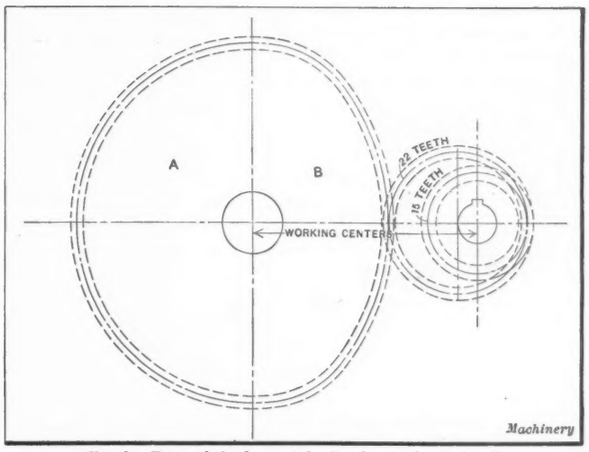



Fig. 2. Type of Oval-eccentric Gearing to be designed

The oval gear shown in Fig. 1 makes but one-half a revolution to each complete revolution of its eccentric driving pinion. Therefore, we may cut away half of the oval gear, as shown in Fig. 3, and mount it on the same shaft with half of a regular spur gear made like that shown in Fig. 4, the pitch diameter of which is equal to the major axis of the oval gear. And then on the shaft with the eccentric driving pinion, we will place an ordinary concentric pinion, the pitch diameter of which is equal to one-fourth that of the half spur gear, mounting this pinion so that it will engage the half spur gear when the eccentric pinion has swung the oval gear into the position shown in Fig. 1. At this point, the eccentric pinion ceases to drive the oval gear, owing to half of it being removed, as already mentioned and shown in Fig. 3. The concentric pinion now engages the teeth of the half spur gear, picks up the load and continues to drive it through the next half revolution of the oval gear shaft, or until the teeth of the working half of the oval gear are again engaged by the eccentric pinion. Owing to the difference in diameters of the half spur gear and its pinion, the latter must make two revolutions before the eccentric pinion

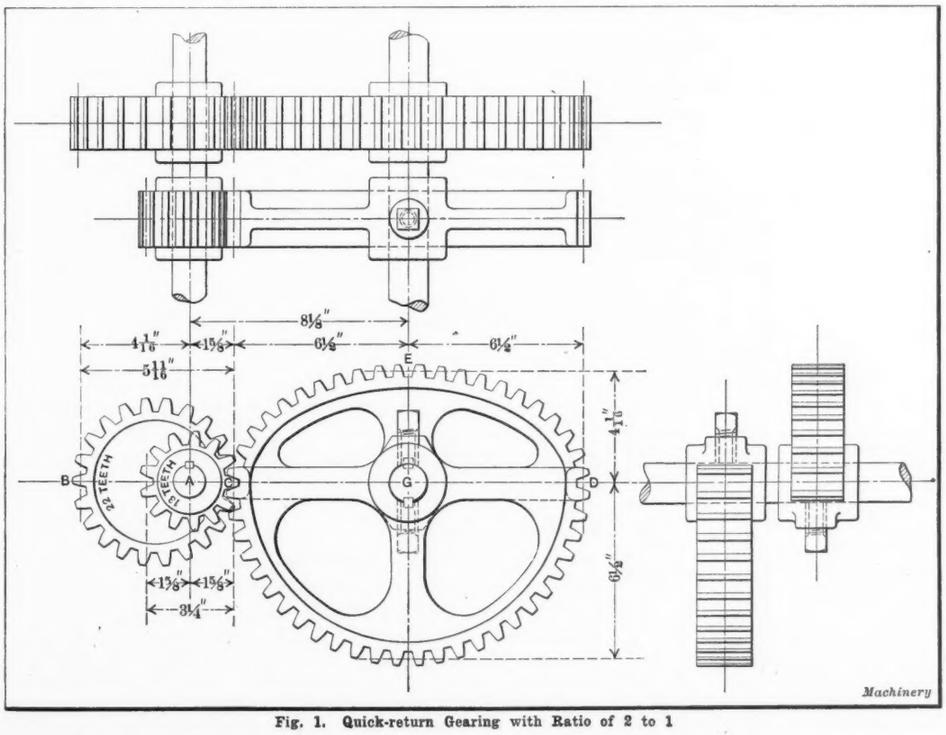



Fig. 1. Quick-return Gearing with Ratio of 2 to 1

can again engage the teeth of its oval mate. It will be noticed that when the eccentric pinion picks up the load it does so at the same speed at which the concentric pinion left it, due to the fact that the short segment of the axis is equal to the radius of the concentric pinion. Now as the eccentric pinion begins to swing the oval gear around, the gear will gain speed until it reaches a point where the long segment of the axis of the eccentric pinion is opposite the minor axis of the oval gear, when it has reached the maximum speed. After that, the speed of the oval gear will gradually decrease until it again reaches that of the concentric pinion, whereupon it will be once more picked up by the concentric pinion and the same cycle will be repeated.

It will be observed, if the foregoing has been carefully followed, that for each three revolutions of the pinion shaft the oval gear shaft makes but one, and that while it takes two revolutions of the concentric pinion to cause the oval gear shaft to make one-half a revolution, the eccentric pinion will drive the oval gear the remaining half revolution while making one turn. It will also be seen that the concentric pinion drives the half spur gear on the oval gear shaft at a slow and uniform speed, during which time the tool should make the cut. After this the eccentric pinion starts to drive, the oval gear rotating slowly at first but gaining headway, reaching the maximum and then falling back to the original slow speed. During this time the tool-head is returned with a quick motion to the starting position ready for the next cutting stroke. The ratio of the quick return to the cutting speed must not be too great or else a jerky motion will ensue that will cause an excessive vibration in the machine. It has been found by experiment that a ratio of 2 to 1 is about the best speed at which the tool can be run, and fortunately, by the combination just described, we obtain this proportion with a smooth easy change from fast to slow, approaching as nearly as possible the ideal motion.

To thoroughly understand the principles involved in the laying out of these gears it may be well to take a specific case and follow it through the several operations required to develop it, from the drawing on paper to the finished pattern ready for casting. As the main feature of this combination of gearing is the oval-eccentric pair, on the proper construction of which depends the success of the quick return, we will give it our special attention, examining the points that determine its size and shape. It may be well, however, before attempting to do any drawing, to state briefly a few cardinal points that are absolutely without change in all gears of this form. First, the long segment (*AB* in Fig. 1) of the eccentric pinion in all oval-eccentric pairs is equal to one-half the distance between the centers of the shafts. Second, the short segment (*AC* in Fig. 1) of the eccentric pinion is equal to one-half the diameter of the concentric pinion running on the shaft with it. Third, the true diameter (*BC* in Fig. 1) of the eccentric pinion equals the sum of its long and short segments (or *AB* + *AC* in Fig. 1). Fourth, the major axis (*CD* in Figs. 1 and 5) of the oval gear is equal in all cases to twice the distance between the shaft centers, less twice the short segment (*AC* in Fig. 1) of the eccentric pinion. Fifth, the minor axis (*EF* in Fig. 5) of the oval gear equals in all cases the distance between the centers of the shafts. Sixth, the oval gear, if complete (as shown in Fig. 5) should have twice the number of teeth that there are in its eccentric driving pinion, and the number of the teeth in both the oval gear and eccentric pinion should be even. Seventh, the shaft hole (*G* in Figs. 1 and 5) of the oval gear is always placed at the intersection of the major and minor axes, or in other words, in the exact center of the oval gear.

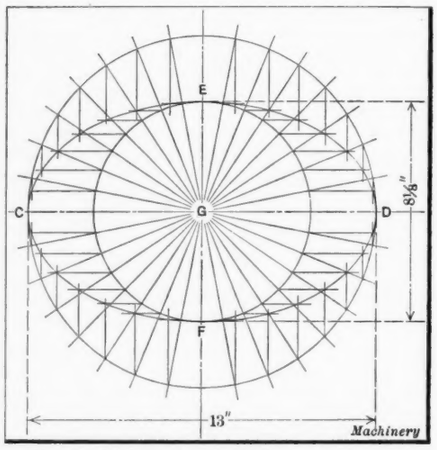
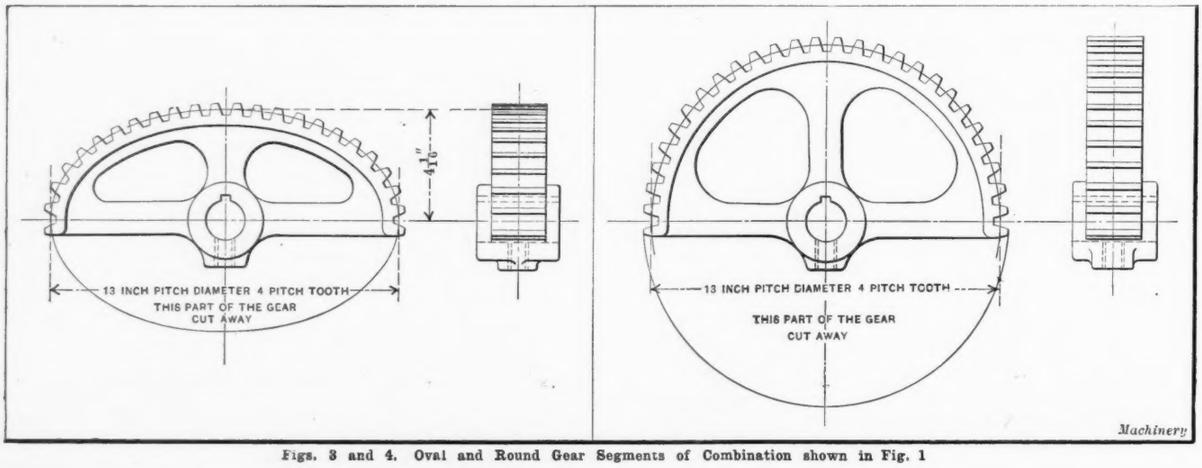



Fig. 5. Diagram showing Method of laying out Oval Gear Segment

With the foregoing rules in mind, let us consider the proper pitch for the gear teeth. These should be of a size to stand up well under the work and show little loss from wear. As 4 diametral pitch answers these requirements and is a good rugged tooth, we will accept it without question for use in this case. Now as the half spur gear makes but one-half a revolution to each two revolutions of its concentric driving pinion, it naturally follows that it must have twice the number of teeth in half its circumference as are contained in the entire periphery of the concentric pinion that drives it. In other words, if the gear were a complete circle, it would have four times the number of teeth in its pitch line that are contained in that of the concentric driving pinion. If, therefore, we assume this circle to contain 52 teeth, then the pinion should have one-fourth that number, or 13 teeth. If we use a 4-pitch tooth, the pitch diameter of the larger gear would be equal to 52/4 or 13 inches, while that of the pinion would be 13/4 or 3¼ inches. As the distance between the centers of the shafts is equal to one-half the sum of the pitch diameters of the intermeshing gears running on them, it would, in this case, equal $\frac{13 + 3\frac{1}{4}}{2}$ or 8⅛ inches.




Figs. 3 and 4. Oval and Round Gear Segments of Combination shown in Fig. 1

Now let us consider the eccentric pinion. We know its long segment to be equal to one-half the distance between the centers of the shafts, also that the short segment is equal to one-half the diameter of the concentric pinion running on the same shaft with it. Therefore, the long segment will equal $\frac{8\frac{1}{8}}{2}$ or 4 1/16 inches, while the short segment will equal

$\frac{3\frac{1}{4}}{2}$ or 1⅝ inch. Now as the true pitch diameter of the eccentric pinion is equal to the sum of its long and short segments, it will, in this case, equal 4 1/16 + 1 5/8 or 5 11/16 inches. This pitch diameter multiplied by the pitch of the tooth gives 4 × 5 11/16 or 22 3/4 as the number of teeth in the pitch circle. This, of course, is impossible, and as it is necessary that the number of teeth in the eccentric pinion be even, we will ignore the extra ¾ tooth and use but 22 teeth. This will necessitate spacing them slightly farther apart, but as the error per tooth is only 0.026 inch, it will not be noticeable on a four-pitch tooth in a gear of this size.

The oval gear should next receive our attention. We know the major axis is the same as that of the half spur gear, which we have found to be 13 inches. Its minor axis is equal to the distance between the shaft centers or 8⅛ inches. Having these figures to work with, we may proceed to construct the oval pitch line of the gear as shown in Fig. 5. First draw the major and minor axes *CD* and *EF*, respectively. Then with *G* as a center and a radius equal to *GD*, draw a circle as shown; and again, with *G* as a center and a radius equal to *GE*, draw another circle concentric with the first. Now draw a series of equidistant radial lines converging to a common point in the center at *G*, and from the points where they cut the smaller circle, draw horizontal lines parallel to the major axis and extending outward from the circle. Then from the points where the radial lines cut the larger circle, draw vertical lines parallel to the minor axis and intersecting the previously drawn horizontal lines at points between the two circles. The points just found lie in the periphery of the oval and by connecting them with suitable curves, the oval pitch line may be laid out. Great care should be taken in obtaining these points to have them absolutely correct and the curves connecting them smooth and even. Otherwise, difficulty will be experienced in finishing the gears so they will run freely.

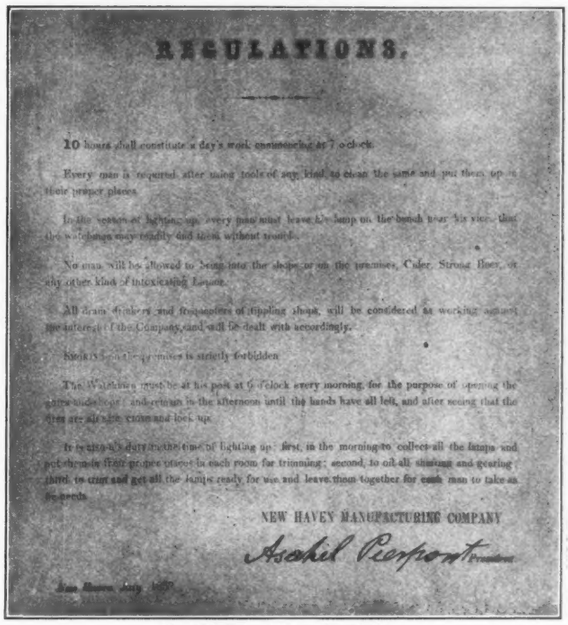
After having obtained the pitch line, lay off the tops and bottoms of the teeth parallel to it and draw in the teeth. If the dividers are used for spacing the teeth, it is advisable to set them at one-fourth the circular pitch, in order that the curve of the pitch line may be more closely followed, the position of the tooth being located by marking every fourth step. When the circular pitch of a given tooth is not known, it may be readily found by dividing 3.1416 by the diametral pitch, and if this be again divided by 4, it will give the proper setting for the dividers. After completing the drawings of the gear, they should be placed in the patternmaker's hands and he should proceed as follows, to make the pattern. First, having prepared a suitable wooden blank, he must make an accurate reproduction of the draftsman's drawing on it, showing the teeth and all other essential parts of the gear. Then with great care, the form of each tooth should be worked out, cutting away the wood until the teeth are all properly shaped. When this has been satisfactorily accomplished, the wooden pattern may be waxed and iron patterns cast from it. In a shop where there is regular gear-cutting machinery, the patternmaker can save himself a lot of unnecessary labor by having a rack of proper size and pitch cut out of a straight piece of clear grained hard wood. From this rack he may remove the teeth and fasten them onto the oval gear blank, one by one, with wire brads and glue. In this case, the gear blank should be shaped to the root diameter of the gear instead of the outside diameter, as in the former case.

The eccentric pinion running with this oval gear is nothing more than an ordinary circular pinion with the shaft hole set off center, and it may be formed in a manner similar to the oval gear, the teeth being fastened to the blank by the method just suggested for those of the oval gear. This will often save a lot of trouble when the pitch circle is of such a size as not to divide easily into an even number of teeth. It is essential, in laying out the oval gear, that both ends of the major axis should bisect a space as shown in Figs. 1 and 3, owing to the fact that in a normally formed oval-eccentric gear pair, the eccentric driving pinion makes two complete revolutions to each one of the oval gear and so corresponding points on the opposite side of the oval should be constructed in like manner; otherwise, the eccentric pinion, which should have a tooth at the end of both the long and short segment of its axes, as shown in Fig. 1, will not mesh properly with it.

* * *

## SHOP REGULATIONS OF 1853

Hanging on the wall of the office of the New Haven Mfg. Co., New Haven, Conn., is a set of regulations that was printed, framed and hung in the shop during its early days. This concern was started in 1851 by Asahel Pierpont who, coming from Springfield, Mass., with several associates, interested New Haven capital and started the company. Like many other shops, this concern started on a small scale but after two years its growth had been so rapid that posted regulations for the guidance of the workmen were deemed necessary. Accordingly, this set of regulations was hung in a conspicuous location in the shop. In general, it will be seen that



REGULATIONS.

10 hours shall constitute a day's work, commencing at 7 o'clock.

Every man is required, after using tools of any kind to clean the same and put them up in their proper places.

In the season of lighting up, every man must leave his lamp on the bench near his vise, that the watchman may readily find them without trouble.

No man will be allowed to bring into the shops or on the premises, Cider, Strong Beer, or any other kind of intoxicating Liquors.

All dram drinkers and frequenters of tippling shops, will be considered as working against the interest of the Company, and will be dealt with accordingly.

Smoking in the premises is strictly forbidden.

The Watchman must be at his post at 6 o'clock every morning, for the purpose of opening the [illegible] and return in the afternoon until the hands have all left, and after seeing that the fires are all safe, come and look up.

It is the watch's duty in the time of lighting up: first, in the morning to collect all the lamps and put them in their proper places in each room for trimming; second, to oil all shafting and gearing; third, to cut and get all the lamps ready for use and leave them together for each man to take as he needs.

NEW HAVEN MANUFACTURING COMPANY

Asahel Pierpont

An Old Set of Shop Regulations

the requirements of sixty years ago were not materially different from those of today, especially as regards the use of intoxicating liquors, or as regulations 4 and 5 put it, "The bringing into the shop of cider, strong beer, etc., is prohibited," and "Dram drinkers and frequenters of tippling shops" are looked on with disfavor. The regulation for the control of the kerosene lamps was given specifically, as these no doubt were a source of trouble and a fire risk.

C. L. L.

* * *

## GERMAN DEFINITIONS OF MACHINE TOOLS

The German definition of machine tools, according to the information published by the British Board of Trade, is as follows: 1. Machines which remove a certain portion of the material during the processes of working, whether in metal or wood. Such machines are lathes, planers, slotting machines, mortising machines, boring machines, milling machines, molding machines for wood, shapers, filing machines, grinding machines, and saws. 2. Machines which cut the material, whether metal or wood. Such machines are shearing machines, punching machines, file-cutting machines, wood-planing machines, and chopping and splitting machines. 3. Machines which alter the form of the material without removing a part thereof. These machines include bending machines, straightening machines, nail-making machines, polishing machines, and wood-working pressing machines. It is evident that with this very broad definition of the expression "machine tool," which differs considerably from the meaning of the same term in this country, a comparison of the trade in machine tools of Germany and of the United States is difficult to make, as here we do not include wood-working machinery under the head of machine tools.

## TRAINING FOR FOUNDRY LEADERS AT WENTWORTH INSTITUTE*

The progress, growth and ultimate development of the foundry industry must depend upon two principal factors. First: the supply of intelligent workers to fill places in the rank and file. Second: the ability, foresight and capacity for leadership of those who are controlling American foundries and foundry operations. The leader in the modern foundry has a variety of responsibilities. His work includes getting business, managing men, the up-keep of complicated mechanical equipment, the development of improved methods of foundry practice, the improvement of the quality of the product and the reduction of production costs. In order to fill his position efficiently, the foundry leader must possess ability which will enable him to do any of the work incident to the operation of his shop, with his own hands. He must be able to know what is a fair day's work and be in a position to instruct his men in any of the work handled in the foundry, or new work which is likely to come in from time to time. His knowledge of the details of foundry practice must be sufficiently intimate to enable him to order each job handled by the most efficient method—which means that the most

General View of Wentworth Institute Foundry

efficient equipment for this particular job must be used—and the work must be handled in a way which will enable the quality of the product to be at least as good, if not better, than that turned out in competing foundries. In addition, the foundry leader must have sufficient engineering training to enable him to exercise supervision over the generation of steam, the transmission of power, the use of suitable methods of ventilation and the application of electricity and compressed air.

Speaking generally, manufacturers appreciate the importance of scientific methods of management and recognize the advantages to be derived from their adoption. But although they understand the value of scientific control of foundry operations, there are a large percentage of foundries where antiquated methods are still in use. Such foundries are forced to continue operating in this way because of their inability to get men with the training and capacity for leadership which is required for operation in accordance with the best accepted standards of the trade. Apprenticeship systems, as carried on in the average foundries, do not produce men with the proper training for successful management of a plant in accordance with the standards outlined in the preceding paragraphs. It will also be evident that practical experience is no longer sufficient to meet existing conditions in the trade and that "rule-of-thumb" methods will not solve the kind of problems which the modern foundryman has to deal with.

Realizing this situation, the Wentworth Institute, Boston, Mass., is now offering a two-year course designed to train men to fill managerial positions. This course is intended to train young men to fill advanced positions in the foundry industry—the positions which require a combination of skill, intelligence and technical knowledge. The intention is to give a broader practical training and a more thorough comprehension of the scientific principles that underlie modern foundry practice than can be obtained through practical experience in commercial shops. First: this course includes a variety of foundry work, and by exercising a careful supervision over individual students to avoid having them do the same work an unnecessary number of times, the equivalent of four or five years' experience gained by following the usual course of apprenticeship, can be secured in two years at the institute. Second: the kind of information that the apprentice is unable to obtain is secured at the institute by text book study, practical talks and lectures. Third: the foundry leader of today must have ability to express his ideas graphically and to read blueprints and drawings. To meet this requirement, the curriculum at the Wentworth Institute includes a course in drafting and design.

Fourth: as rapid and accurate computations of a great many kinds must be made in the foundry, a systematic course of instruction in making estimates of costs and quantities of material, and various other calculations involving the use of formulas of a more or less complicated character, is given. Fifth: the general principles of engineering and applied science which the progressive foundryman should have a knowledge of, are taught; and a special laboratory equipped with the necessary equipment is provided in order that the students may obtain practical knowledge of this part of their profession. Sixth: special emphasis is laid upon instruction in foundry chemistry, and in chemical and metallurgical engineering. This part of the course includes a particularly thorough training in the principles of combustion and the effects of temperature. Two laboratories are devoted especially to this part of the work. Seventh: as it is believed that the capacity for leadership can be developed, the students at the institute are given the opportunity to act as foremen, directing work of an increasingly difficult and complex character as their capacity for duties of this nature increases.

* Abstract of a paper read before the annual convention of the American Foundrymen's Association in Chicago, October 5-11, 1914.

* * *

## ELECTRIC CONDUCTORS

It is well known that the resistance of metal conductors to the flow of electricity diminishes with a decrease in the temperature. In the case of very pure platinum, for instance, the resistance at the lowest temperatures obtained with hydrogen—between 423 and 434 degrees F. below zero—is only 1/100 of the resistance at ordinary temperatures. In the case of very pure gold, the resistance at this temperature is only 1/300 of the resistance at ordinary temperatures. In 1908, Prof. Onnes succeeded in liquefying helium, and in this way was able to reach temperatures around 455 degrees F. below zero. He concluded that at these low temperatures the resistance to electric currents in metals would be almost negligible, and from experiments undertaken he has arrived at the conclusion that with absolutely pure platinum, as well as with other metals, the resistance is so small that it is non-measurable. A coil was made from fine lead wire having a diameter of 0.0006 inch, the length of which was one centimeter (0.4 inch approximately), containing 1000 turns per centimeter. At the liquefying point of helium, a current of 0.8 ampere would be transmitted through this wire without encountering any measurable resistance. Hence, it follows that an electric current can be induced in a conductor at extremely low temperatures and continue to flow without electromotive force acting in the circuit. In fact, Prof. Onnes has calculated that in the lead coil mentioned it would take more than a day for the current to die out at the extremely low temperature under consideration.

* * *

It is stated in the *Scientific American* that if oxygen is added to the air-blast for a blast furnace, so that it is present to an extent of 23 per cent in the air instead of the normal 21 per cent, there is a saving of from 110 to 130 pounds in the amount of coke required to smelt a ton of iron, and the iron produced is said to be of a higher quality.

# NEW MACHINERY AND TOOLS

THE COMPLETE MONTHLY RECORD OF NEW DESIGNS AND IMPROVEMENTS
IN AMERICAN METAL-WORKING MACHINERY AND TOOLS

## BAUSH MULTIPLE SPINDLE DRILL

To meet the requirements of the Ford Motor Co. in drilling flywheels, the Baush Machine Tool Co., 200 Wason Ave., Springfield, Mass., has recently built two multiple spindle drilling machines, one of which is illustrated in Fig. 1. These machines are made in three different sizes, and are adapted for a variety of multiple drilling, reaming, counterboring and similar operations. It will be evident that the design has been worked out in such a way that holes can be drilled on the closest possible centers. This is due to the fact that holes which are located too close together to be machined by drills held in the same head, may be handled by successive heads on the machine. The multiple head feature also makes it possible for heavy and light drills to be grouped together so that both may be operated at suitable speeds and feeds.

It has already been mentioned that these machines were built for drilling flywheels in the plant of the Ford Motor Co., but it must not be thought that this is a single-purpose machine, for after reading the description it will be evident that there are a great many classes of work that could be handled on it in a very advantageous manner. There are eighty-one drilling operations on the Ford flywheel, and using this machine it has been possible to perform all of the drilling operations on a wheel in fifty-four seconds. Two of these machines which are now in use are drilling 1000 flywheels in eight hours with an actual rate of production of 510 wheels for each machine in 450 minutes. The operations illustrated in Figs. 2, 3 and 4 consist of first drilling sixteen holes in the inner circle through about 1⅛ inch of metal, and sixteen holes on the outer circle half way through the same thickness of metal; second, counterboring the sixteen holes in the inner circle and drilling the holes in the outer circle through the remaining metal, a smaller sized drill being used for this purpose; third, milling or counterboring three half round faces in the hub of the wheel; fourth, drilling nine holes near the center of the wheel; fifth, reaming five holes. Each of the tools employed for these operations is operated at the proper speed and feed, and each cluster is provided with a jig which is used at that station and no other.

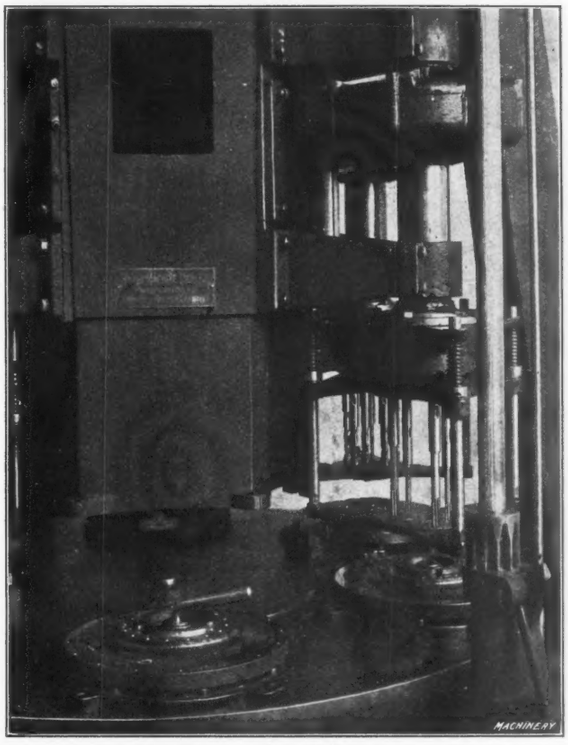



Fig. 2. Loading Station where Work is set up on Machine

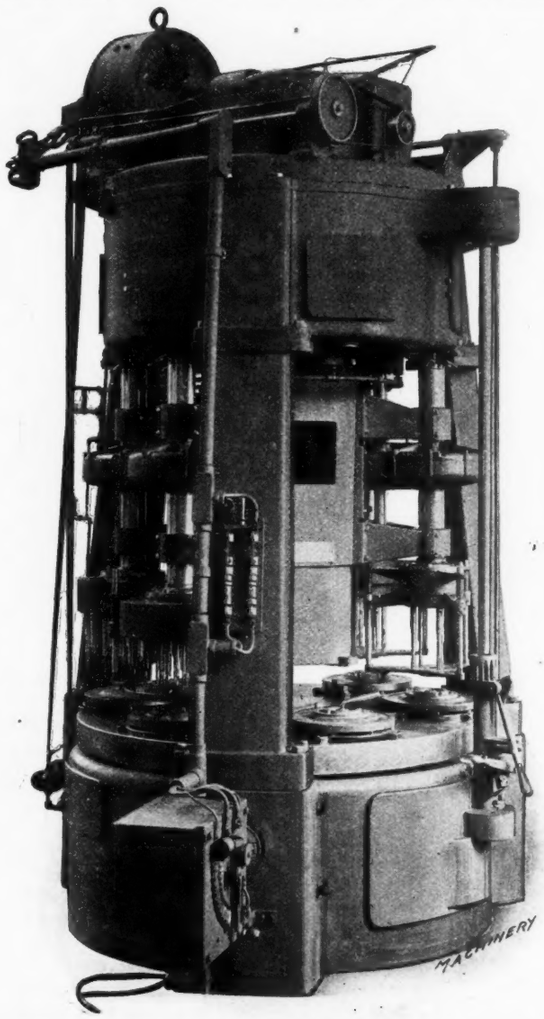



Fig. 1. Baush Multiple Spindle Machine for drilling Ford Flywheels

In operating the machines, each flywheel is placed on a supporting block and secured by means of an expanding center. The "loading station" of the machine is illustrated in Fig. 2, and the wrench used for expanding the center on which the flywheel is held is also shown in this illustration. The counterbore in the wheel, which is the important part, is used to locate the work under each jig, this result being obtained by a tapered leader which enters the counterbore as the jig at each station on the machine comes down to the working position. In addition to this counterbore, there is a flat dowel in the supporting block which registers between two jaws on the extreme outside portion of the jig, thus securing the wheel against rotation.

The feed is accomplished by means of a barrel cam which is of the correct form to give a quick approach, and the desired rate of feed and return. By employing different cams, suitable rates of feed can be obtained for the tools in different heads. The table is rotated by a mechanism which also lifts it, allowing the weight to be carried on a center pintle while it is in motion, and the provision of ball bearings in this connection makes it possible for the table to be moved very easily. A hardened steel locking bolt is

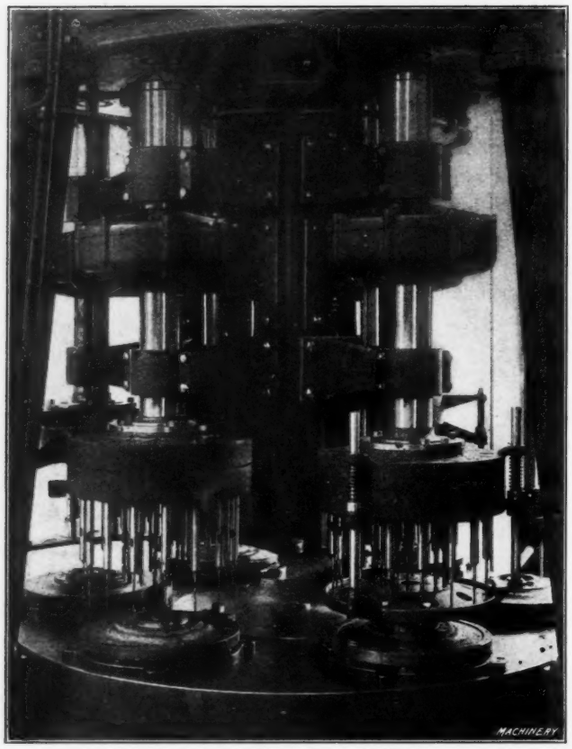


Fig. 3. View showing Different Sizes of Drills grouped in Separate Heads

provided, which is actuated by a cam and comes into play just before the table is lowered to its working position, where the bolt locks the table in place. When in the working position, the table rests on a circular rail which is slightly smaller than its outside diameter, this rail being carried up inside the flange at the periphery of the table to protect the bearing from chips. One central oiling system is provided which delivers lubricant to all bearings, the pump taking the oil from a tank in the base and circulating it through a system of return piping.

Each head is counterweighted, and different standard spindle clusters may be furnished to meet the requirements of different classes of work. These clusters may be readily removed to enable different ones to be substituted. The regular adjustable drill head of the well-known Baush type can also be used to adapt the machine for more or less general classes of multiple drilling. At the loading station shown in Fig. 2 it will be noted that the operator has a switch and starter which control the motor located at his left hand, and a small lever which governs the feed mechanism at his right hand. The last named lever enables him to instantly stop all of the feeding motions, including the indexing of the table, thus placing the machine under absolute control. The drive is from a 25-horsepower Westinghouse motor mounted on the head, power being transmitted through gearing. The machine is of very massive construction, which will be readily appreciated when it is known that the weight is 20,000 pounds.

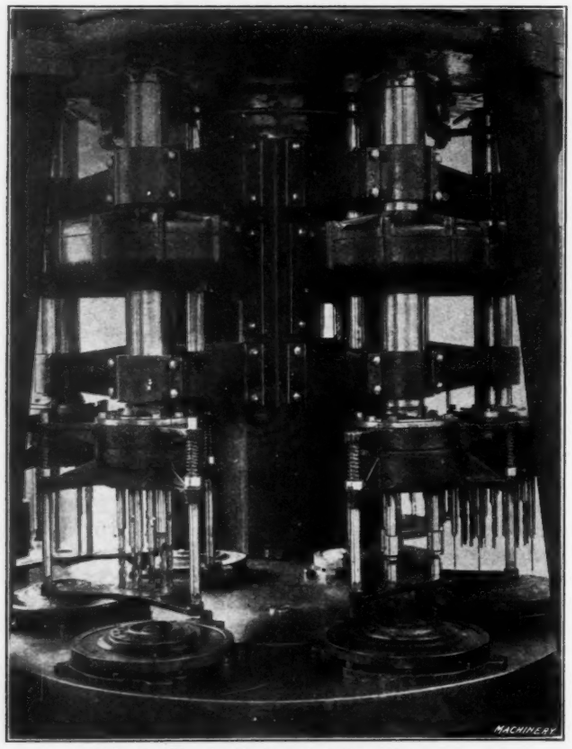


Fig. 4. The Application of Drills and Reamers

## O. K. ALTERNATE ANGLE MILLING CUTTER

The O. K. Tool Holder Co., Shelton, Conn., is now manufacturing what is known as an "alternate angle," inserted-tooth milling cutter. The body of this tool is made of chrome-nickel steel and the inserted teeth are forged to the required shape by hydraulic pressure, and held in place by suitable clamping wedges. It will be seen that the teeth are inclined in opposite directions, their angle of inclination with the axis about which they rotate being 20 degrees, and the rake 15 degrees from the radial line. The inserted teeth are

Fig. 1. 6 by 1 inch O. K. Alternate Angle Cutter in Operation

provided with shanks which fit into sockets in the body of the cutter, and the wedges which hold the teeth in place are tightened by means of socket head screws. When the screw in each wedge is driven in, the wedge is pulled down and its inclined side bears against the tooth and holds it firmly in place.

Fig. 2 shows six of these cutters assembled for a slabbing operation. The cutters are held together by means of bolts which pass through four holes in each cutter, the bolts being of suitable length for the number of cutters which it is required to use. In Fig. 1 a cutter 6 inches in diameter by 1 inch face width is shown milling a 30 point carbon open hearth steel forging. The cutter is run at a surface speed of 190 feet per minute and the work is fed to the cutter at the rate of 4½ inches. It will be seen from the scale held beside the work that the depth of cut is 1¼ inch, and the chips

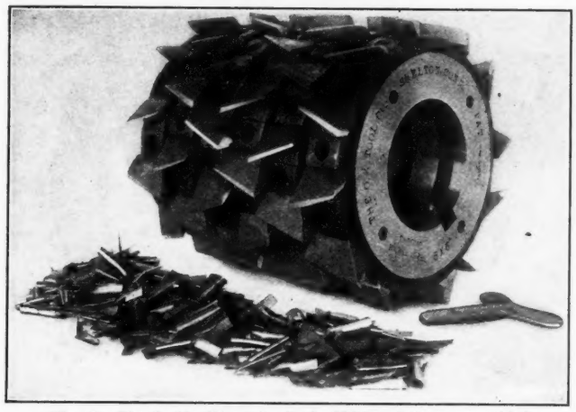


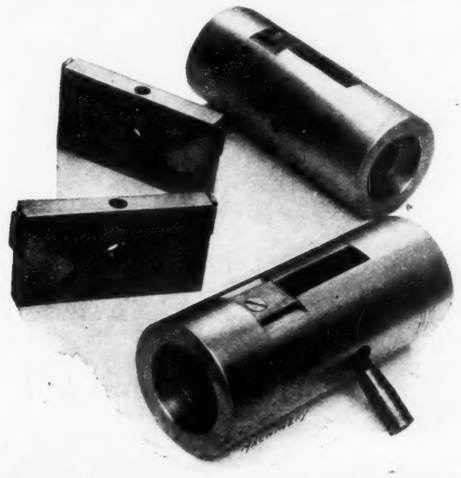
Fig. 2. Six O. K. Alternate Angle Milling Cutters assembled for a Slabbing Operation

shown in the illustration give some idea of the way in which metal is being removed. Another test made with a cutter 4 inches in diameter by 1 inch face width consisted of driving the cutter at a surface speed of 200 feet per minute, the depth of cut being ½ inch; and under these conditions it was possible to feed the work to the cutter at a rate of 15½ inches per minute. In another test conducted with a 4 by 1 inch cutter, the surface speed of 200 feet per minute was employed with a depth of cut of ⅛ inch; and under these conditions the work was fed to the cutter at a rate of 40 inches per minute. In all of these tests the same material was used.

To give an idea of the capacity of these tools when used in multiple for slabbing operations, the following test may be cited. Four cutters 4 inches in diameter by 1 inch face width were run at a surface speed of 200 feet per minute, with a depth of cut of ⅛ inch. Used in this way it was found possible to feed the work to the cutters at the rate of 12½ inches per minute. A simple test which shows the ease with which these cutters remove metal consists of operating the feed by hand. If this is done, it will be seen that very little force is required to overcome the resistance offered by the work to the passage of the cutters over it.

## KELLY BORING OR REAMING HEAD

The XX Type C boring or reaming head which is illustrated herewith is the latest product of the Kelly Reamer Co., Cleveland, Ohio. This head is adapted for use on the engine lathe, turret lathe or vertical boring machine and is made in diameters ranging from 2½ to 6 inches. Kelly boring or finishing reamers from 3 to 12 inches in diameter may be used in different sizes of these heads. It will be seen from the illustration that the head has a threaded socket at each end and pieces of shafting may be screwed into both ends of the head to form a lathe boring-bar of any desired length. When the head is to be used on a turret lathe, only one piece of shafting is screwed into it; and by using a tapered shank in one end of the head, it is converted into a serviceable vertical boring or reaming tool. An important advantage of this construction is that it is only necessary to ship the head to the purchaser, so that the transportation charges on heavy bars are saved.



Engraving made from "Mirror Photograph" of Kelly Boring Head

These heads are made with 0.0005 inch side float and 0.00025 inch end float, which experience has shown to be suitable for properly carrying out the floating reamer principle, giving the rigidity of a solid tool and the accuracy and finish to the work obtained with a floating reamer. The roughing and finishing reamers are interchangeable in the slot in the head, and are held in place by the taper locking bolt at the center. This bolt is tightened for the boring operation and loosened slightly to give the reamer the necessary "float" for finishing. Used in this way, a cylinder may be bored to within 0.005 to 0.006 inch of the required size, after which the floating reamer removes the feed marks, insuring the required accuracy and finish. The illustration presented in this connection is a reproduction of what is styled a "mirror" photograph. This is nothing more nor less than a photograph of the head taken in front of a mirror, so that a direct view of one side and a reflected view of the opposite side are obtained. The use of these mirror photographs in mechanical work makes it possible to secure two views of an object with the expense of making only one negative. It will be seen that the reamer and taper locking bolt are shown removed from the head, thus giving a good idea of their form.

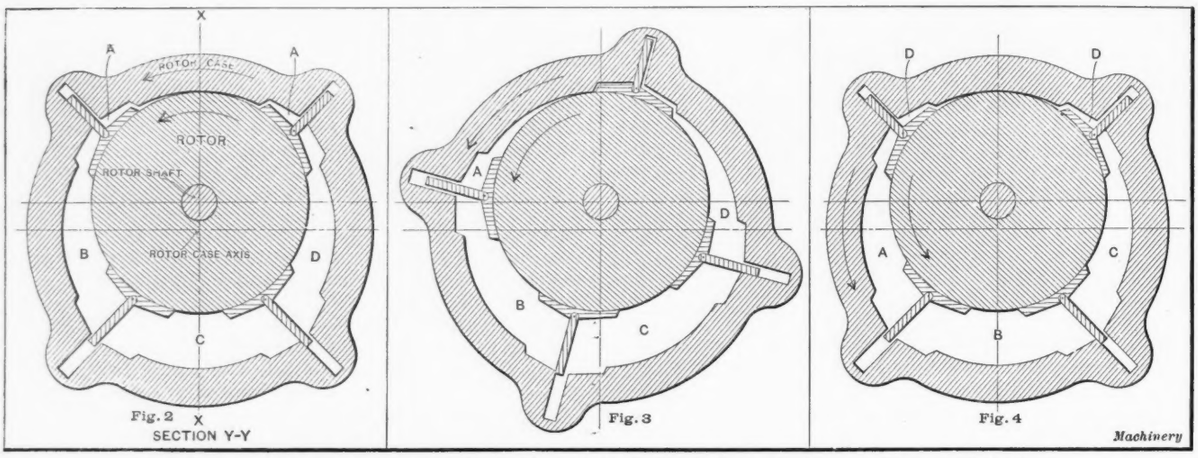
## NEW BRITAIN BUFFING LATHE

The New Britain Machine Co., 64 Bigelow St., New Britain, Conn., has recently added to its line the ball bearing buffing lathe which is illustrated herewith. The spindle of the machine is driven from below with the belt completely enclosed

New Britain Buffing Lathe with Head in Operating Position

in the base, so that the danger of accidents resulting from the operator being caught by the high-speed belt is entirely eliminated. This also makes a very compact construction, which results in a material saving of floor space; and the air currents set up by an exposed belt, causing dust and lint to be suspended in the atmosphere of the buffing room, are done away with so that the exhaust system on each machine is able to work at maximum efficiency. As a result, the unhealthful condition produced by having the operators inhaling dusty air is avoided.

In order to start the machine, it is merely necessary to pull the handle up to the position shown in the illustration. The entire head is hinged at the back, and when the handle is pulled up to the position shown, a toggle joint raises the head sufficiently to bring the belt into contact with the lower




**Figs. 2 to 4. Diagrams showing Successive Positions of Air Pocket during ¼ Revolution of Rotor and Rotor Case**

or driving pulley. This simple method does away with the necessity for clutches, idler pulleys, loose pulleys, etc., and makes the shifting of belts unnecessary. The belt is adjusted to the proper working tension and is only under this tension while the machine is in actual operation. When the machine is stopped, the tension in the belt is relaxed, and in this way the length of life of the belt is materially increased. The head is of massive construction to avoid vibration, but the toggle action of the handle employed to lift the head and bring the belt into contact with the driving pulley, is such that very little exertion is required to start the machine.

The spindle is made of special carbon steel and is mounted in four self-aligning ball bearings. These bearings are continually oiled and the pressure is distributed over one hundred balls so that smooth running of the spindle is insured at all times. The spindle and pulley may be removed and the lathe taken apart without requiring the belt to be cut; and access to the belt is had through the hand holes on top of the machine and in the side of the base. Single- or double-end shafts are furnished according to the requirements of the shop in which the machine is to be used. As the machine may be started promptly and stopped instantly by means of a brake, there is little time lost in changing buffs, and as a result, it is economical to use double-end spindles with two operators working at each buffing lathe.

## WERNICKE-HATCHER ROTARY AIR COMPRESSOR

What represents a radical departure from standard practice in the design of air compressors has been made by the Wernicke-Hatcher Pump Co., Grand Rapids, Mich., in the construction of a new air compressor which has recently been placed on the market. This is of the rotary type and is said to possess several noteworthy advantages over the reciprocating form of equipment. No vibration is introduced at the points of reversal, so that wear resulting from this cause is eliminated; a uniform supply of air is delivered to the receiver; and as the rotor case is rotating at high speed and constantly exposed to fresh air, while the radiating surface remains constant, the possibility of the compressor overheating is done away with, without employing a water cooling system.

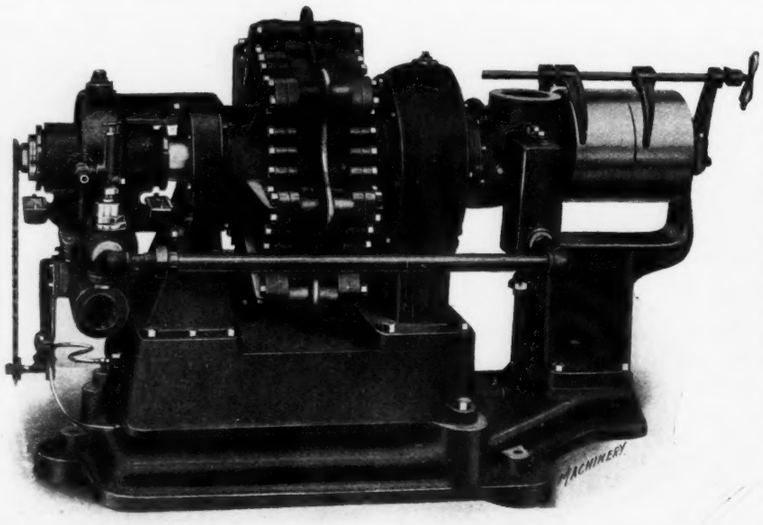



**Fig. 1. Wernicke-Hatcher Rotary Type of Air Compressor**

The principle upon which this equipment operates may best be explained in connection with Figs. 2, 3 and 4, which are simplified diagrams in which details are omitted and proportions amplified to make the idea as clear as possible. It will be seen that there is a rotor which revolves inside of a rotating case. This rotor has shoes secured to it at equal intervals, and vanes are secured to these shoes which work in grooves in the rotor case. In this way the vanes divide the space between the rotor and the rotor case into pockets. The diagrams show four pockets, but there are eight pockets in the regular compressor. The rotor and the rotor case run at the same number of revolutions per minute, but it will be seen that these two members are carried by shafts that are eccentric to each other. The result is that each pocket between the rotor and the rotor case varies in size according to the position of the rotor and case.

As any given revolution takes place, each pocket gradually increases in volume and draws air into it through the intake valve. When the pocket has reached its maximum volume, the intake valve closes and the continued rotation of the rotor and case results in a contraction of the volume of the pocket. This means that the air in the pocket is compressed, and as the compression continues the outlet valve opens, admitting the compressed air to the receiver. This principle will be readily understood by referring to Figs. 2, 3 and 4, which show the change in volume of the pockets resulting from a rotation of one-fourth revolution. In Fig. 2, the pocket *A* is in its position of minimum volume; in Fig. 3, one-eighth revolution has been completed and the pocket *A* has opened slightly; while Fig. 4 represents a rotation of one-fourth revolution from the position in Fig. 2, or one-eighth revolution from the position in Fig. 3, which has resulted in a further expansion of the volume of the pocket *A*. While this takes place air is being drawn into the pocket, this action being continued until the pocket *A* reaches the condition shown by the pocket *B* in Fig. 4. At this point the intake valve will close and further rotation results in the compression of the air in the receiver.

Fig. 5 shows a cross-sectional view along the line *XX* from

which it will be seen that the intake and discharge ducts are located inside the shaft on which the rotor revolves. Referring now to the general view of the machine shown in Fig. 1, it must be understood that this illustration is located in the reverse position to the cross-sectional view shown in Fig. 5, *i. e.*, the discharge ports are located at the left-hand end of the machine in this illustration, while they are shown at the right-hand end in the cross-sectional view. It will be seen that pulleys are provided for transmitting motion to the gearing which drives the rotor and the rotor case, but individual motor drive may also be employed. At the left-hand end of the machine there is a chain driven pump which draws oil from a reservoir in the base and delivers it to all members which are supplied by a forced system of automatic lubrication. This rotary air compressor is adapted for use in plants where air at a pressure up to 100 pounds per square inch is used.

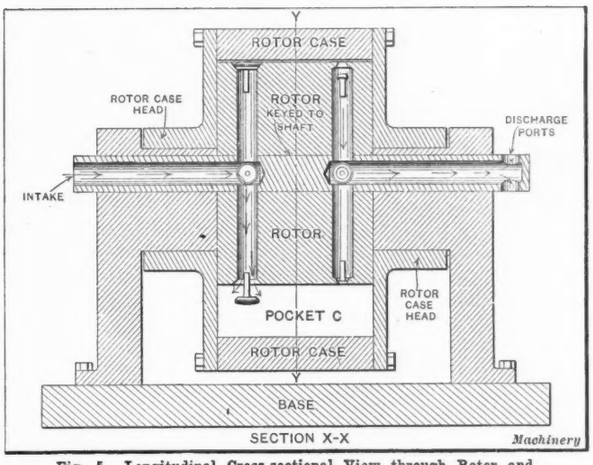


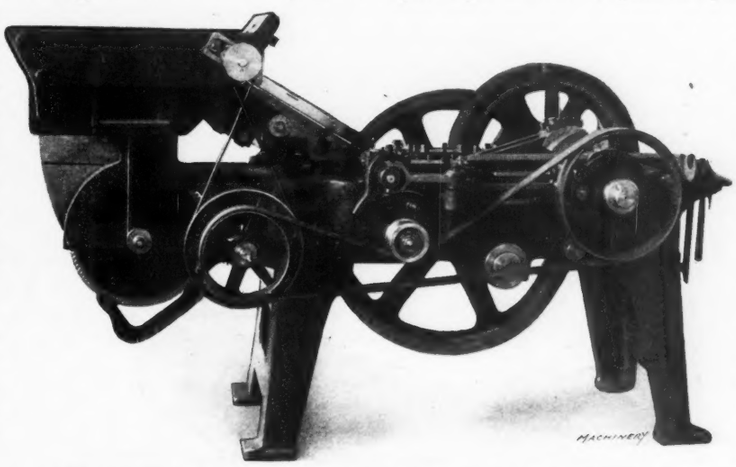

Fig. 5. Longitudinal Cross-sectional View through Rotor and Rotor Case

The machine is 46 inches long by 28 inches wide by 35 inches high. The capacity is approximately 75 cubic feet of air per minute at a pressure of 100 pounds per square inch, when the machine is running at 400 revolutions per minute. Under continuous operation at this speed, the discharge temperature will not exceed 275 degrees F. when the intake temperature is not above 60 degrees F. The weight of the machine without the sub-base is 1400 pounds.

## WATERBURY-FARREL BOLT HEAD TRIMMING MACHINE

To meet the demand for automatic machines for trimming the heads of bolts, the Waterbury Farrel Foundry & Machine Co., Waterbury, Conn., has recently brought out a line of machines for handling this class of work. These are built in sizes capable of trimming the heads of bolts up to and including ⅝ inch in diameter, and up to a maximum length of 6 inches. These machines are primarily adapted for trimming cold-headed blanks with either a square or hexagon form of head. They may, however, be successfully employed for trimming the flash from hot forged bolt heads, and in such cases the diameter of the bolts which can be handled is somewhat larger than in the case of cold-headed blanks. Care must be taken, however, that the heads are concentric with the shanks.

In operating a machine of this type, the blanks to be trimmed are placed in the hopper, from which they slide down an inclined chute suspended by their heads. At the bottom of this chute, the bolts are carried one at a time to a position in line with and between the trimming punch and die, where they are held in a horizontal position. An interesting form of transfer mechanism is used for this purpose which picks up one blank from the bottom of the column of blanks in the chute, revolves it into a horizontal position, and then carries it over to the punch and die. The hollow punch then advances onto the shank or body of the blank until it reaches the under side of the head, when further motion of the punch forces the bolt head into the die, thus causing it to be trimmed to the required shape. The bolt remains with the head held in the die and the shank projecting out until the slide has returned almost to its starting position, at which time the bolt is pushed out of the die by a positive knock-out which is operated by the slide.



Waterbury-Farrel Bolt Head Trimming Machine for Bolts up to ½ by 6 Inches

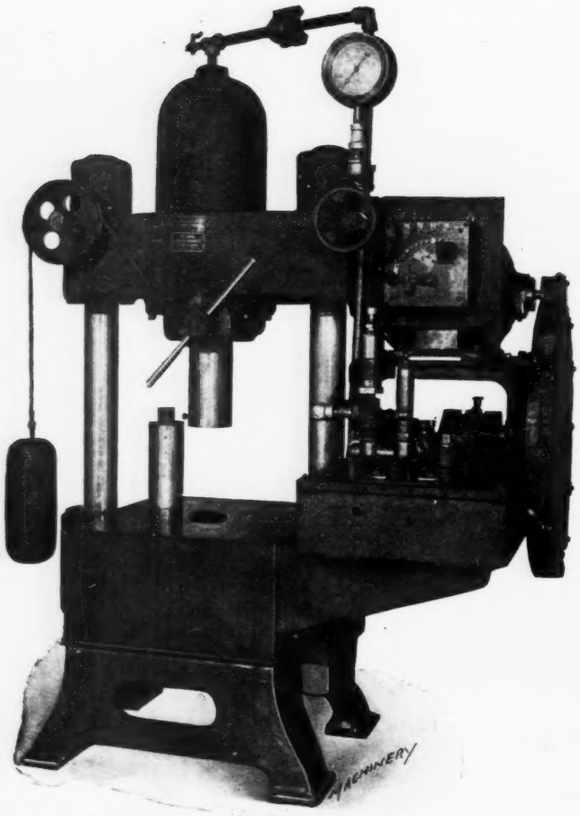
The machine shown in the accompanying illustration is the No. 3 size, which has a capacity for trimming the heads of bolts up to ½ inch in diameter by 6 inches in length. Attention is called to the fact that this machine is made with a back-geared drive which provides ample power for handling the work. Another feature is the compactness of the design, which reduces the amount of floor space required to a minimum. This is a particularly valuable feature in factories located in congested districts where rent is very high.

## HYDRAULIC BROACHING AND FORCING PRESS

The accompanying illustration shows a self-contained hydraulic broaching and forcing press which has both the motor and pump mounted on a base which extends out at one side of the machine. This constitutes a recent addition to the line of the Hydraulic Press Mfg. Co., 84 Lincoln Ave., Mount Gilead, Ohio. It is of sturdy, though compact construction, and is suitable for a wide range of broaching and forcing operations in machine shops, garages, etc. The ram is counterbalanced and controlled by a hand windlass which enables it to be raised or lowered for handling various sizes of work. When the ram is moved down by the hand windlass, the cylinder is filled with water by suction, so that the pressure is applied as soon as the pump is started. Extension blocks may be used on the ram varying in shape and length according to the size of the pressing surface.

The ram is operated by a two-plunger, horizontal pump which has plunger diameters that may be varied from ⅝ inch to 1 inch, with a constant stroke of 3½ inches. The pump is equipped with an automatic knock-out attachment which limits the pressure to a predetermined maximum value according to the requirements of the work. All parts of the pump are easily accessible so that it is an easy matter to make adjustments or re-pack the pump plungers when necessary. The gearing shown in the accompanying illustration has a single reduction, but double reduction gearing may be provided on the pump, if required. The motor and starting rheostat are conveniently located within reach of the operator. A 2-horsepower motor is required.

The speed at which this press may be operated varies with the diameter of the pump plunger; the larger the plunger the more rapid will be the movement



Self-contained Hydraulic Broaching and Forcing Press

of the ram, as more water is forced into the cylinder at each stroke of the pump. The press shown in the illustration has a ram 10 inches in diameter and has a capacity for pressures up to 75 tons. The stock space of this press is 18 inches and the traverse of the ram 12 inches. The working surface of the bed is 24 inches square and there is an opening directly under the ram to receive the broach as it passes through the work, a wooden box being placed to receive the broach when it drops.

## BUFFALO DOUBLE-END SHEAR

The Buffalo Forge Co., Buffalo, N. Y., is now building a double-end shear which is especially adapted for use in cutting angle irons up to 6 by 6 by ¾ or tees 4 by 4 by ⅜ inch in size. In order to make the machine as compact as possible, and still provide ample strength, the frame is made of armor plate. The drive is from a 10-horsepower 440-volt, 25-cycle 3-phase alternating-current motor, belted to the flywheel of the machine. The power is transmitted through heavy double reduction gearing, the high- and low-speed shafts running entirely through the housing. A jaw clutch on the flywheel side of the machine provides for engaging or disengaging the power as required. This clutch is thrown out automatically by means of a cam mechanism, so that the plunger can make but one stroke unless the engaging lever is held down.

The shaft on which the clutch is mounted carries an eccentric which is located inside the housing of the machine. When the clutch is engaged, this eccentric transmits the motion to both of the plungers on which the shear blades are mounted. The clutch is controlled by the lever shown near the center of the frame in Fig. 2. The machine is especially useful for making right- and left-hand cuts for mitering. When used for this purpose, the operator makes the first cut on one end of the machine and then brings the work over to the other end on the same side to make the second cut. When used for straight cutting, two gangs of men can be employed, working independently, each gang using one of the two sets of shear blades. An adjustable hold-down provides for holding the work in place while it is being cut. The weight of the machine is 12,000 pounds.

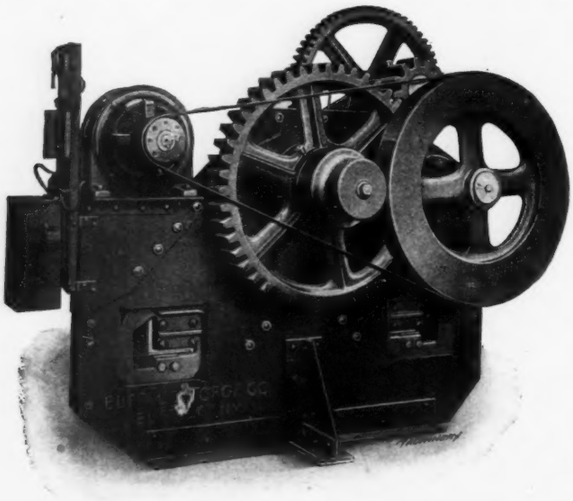


Fig. 1. Buffalo Shear showing Arrangement of Drive

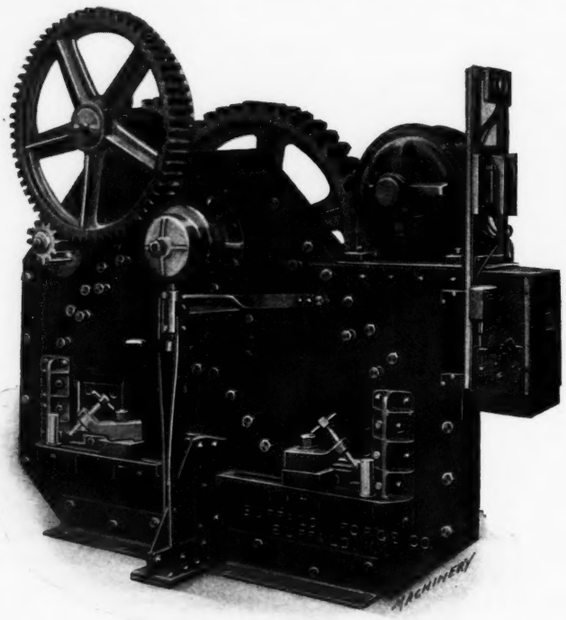
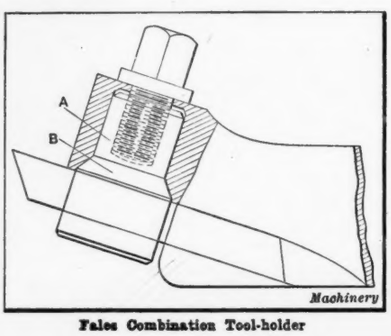


Fig. 2. Operating Side of Buffalo Double-end Shear

## FALES COMBINATION TOOL-HOLDER

The important feature of the combination tool-holder which forms the subject of this article is the simplicity of its design combined with the possibility of using it as either a straight, left-hand or right-hand holder. The holder may also be used in connection with a threading tool, for which purpose it gives very satisfactory results. Practically the entire reaction of the cut is carried by the shank of the tool; this result is obtained by the close fitting bearing *A* of the clamp, the binding screw being merely depended upon to keep the cutter from slipping. The enlargement of the clamp provided through the taper *B* gives an exceptionally long support for the cutter and greatly reduces the possibility of breaking it. Another

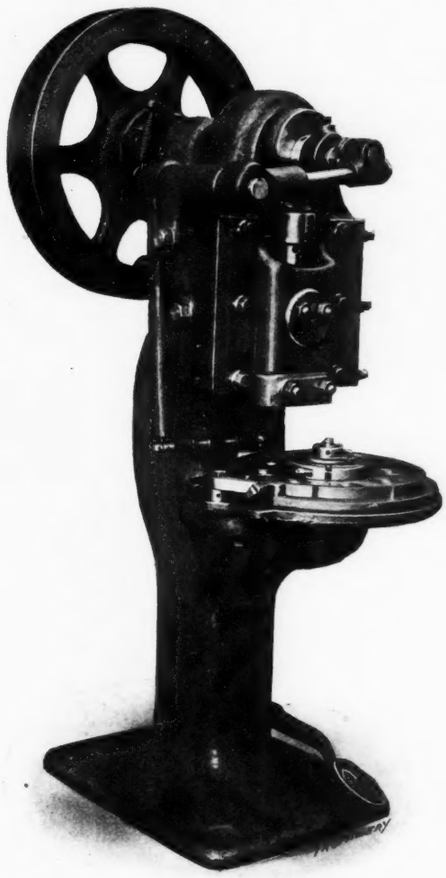



Fales Combination Tool-holder

feature is the ease with which a broken screw may be replaced. When the screw is broken, the clamp and cutter drop out of the holder so that the tension of the screw is released and it may be removed with the fingers. This tool is known as the "Duckett" combination tool-holder, and is a recent product of the C. E. Fales Machinery Co., Kerr Bldg., Detroit, Mich.

## FERRACUTE DIAL FEED

The Ferracute Machine Co., Bridgeton, N. J., has recently developed an improved dial feed attachment which is shown in the accompanying illustration mounted on a power press of this company's manufacture. The mechanism which imparts intermittent motion to the circular plate is made quite heavy so that ample strength and rigidity are provided. As



Ferracute Power Press equipped with Improved Dial Feed

the press shaft revolves, it transmits motion to a bellcrank lever, the lower end of which is connected to the yoke surrounding the dial by a horizontal pitman. In this way the yoke is given a reciprocating motion, and a pawl attached to the yoke moves the dial, the angular position of which is exactly located by means of a spring lock. The tension of the spring which governs the position of the dial is made adjustable, which is also the case with the brake at the center of the dial. The pitman is provided with a universal joint at each end and has means for making ample longitudinal adjustment.

## BAIRD TANDEM PRESSES

Power presses are made in various types, but the two most important classes are single-action and double-action presses. Each class is adapted for handling certain kinds of work, and each has its limitations. The single-action press is by far the more commonly used and the operations sometimes attempted on it require tools which are both costly to make and to operate, owing to their complicated construction and the difficulty experienced in adjusting them. It is common practice to handle work on a single-action press which requires

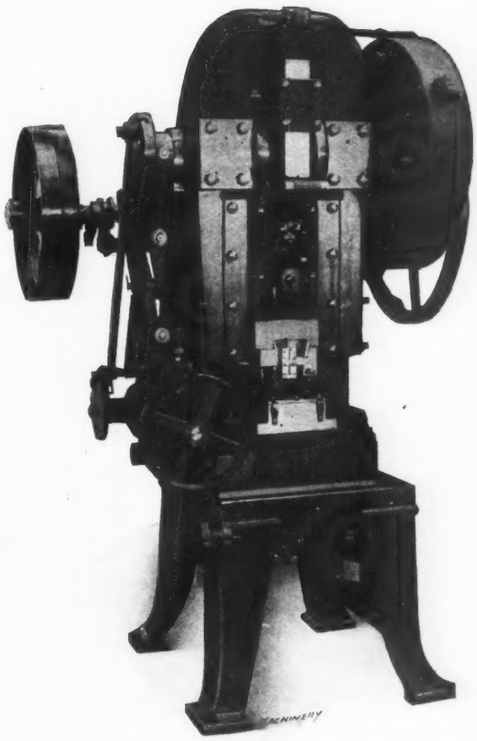


Fig. 1. Baird Tandem Press with Double-action Front Slide and Single-action Rear Slide

more than one stroke to complete it, but it is not so easy to utilize more than one stroke of a double-action press at one feeding of the work. There are, however, many articles which require subsequent operations after the blank has been cut from the stock and drawn. To meet the requirements of such work, the Baird Machine Co., Bridgeport, Conn., has brought out a new line of presses. These are styled

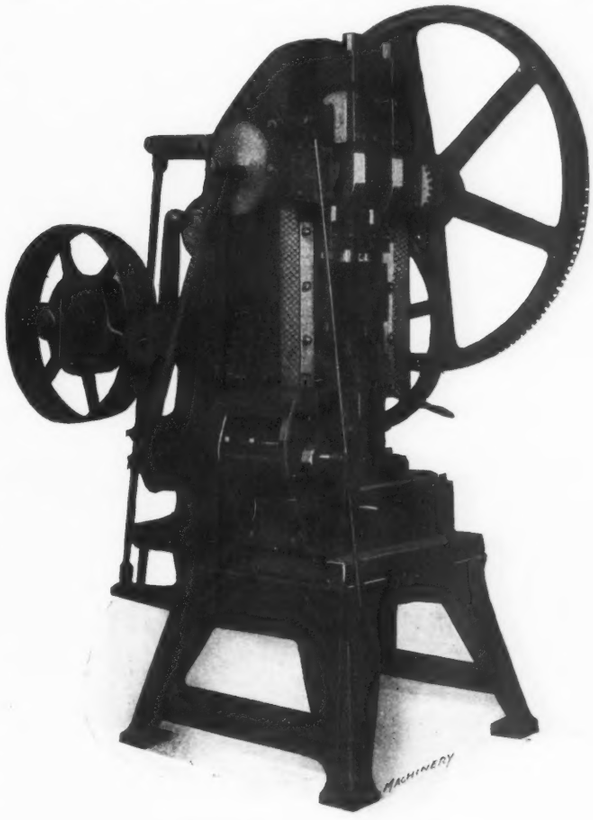


Fig. 2. Another Size of Baird Tandem Press

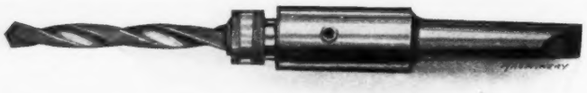
"tandem presses" and consist of a double-action front slide combined in the same frame or housing with a single-action rear slide. An automatic roll feed mechanism, a transfer mechanism for automatically moving the work from the front to the rear slide and lifting pins or knock-outs for both slides, constitute part of the regular equipment of these machines.

The blanking stroke of the front slide is cam-actuated, allowing the blanking tools to hold the work and preventing it from wrinkling while the drawing operation is taking place. Both the blanking slide and the drawing plunger are provided with means of adjustment to compensate for wear of the tools. The transfer mechanism is of an improved design and equipped with two fingers suitably shaped to fit the work. The mechanism for gripping and releasing the work is independent of that employed for moving the transfer from the front to the rear slide of the press. The distance through which the transfer moves can also be adjusted to suit the shape and character of the work which is being handled. The rear slide of the press is single-action and crank-actuated, the crankshaft, connection slide and ways being entirely independent of the front slide of the press. It may be set to act in unison with or slightly before or after the front slide according to the requirements of the work. The connection is provided with the usual means of adjustment to take up wear in the tools. In the standard type of machine, the stroke is suitable for stamping or forming operations, but the stroke can be varied to meet the requirements of redrawing operations.

The class of work for which these presses are particularly adapted is a shell with the bottom stamped or pierced; or a ferrule made by drawing a shell and blanking out the bottom. The drawing motion of the front slide may, however, be used to carry a shell or partially formed blank down into the transfer slide instead of performing a drawing operation. On this class of work the tandem press is far more efficient than a single-action press equipped with a transfer mechanism, because each slide may be adjusted independently of the other. These tandem presses are made in four sizes weighing from 1500 to 8500 pounds. All sizes are back-geared, the back-gear shaft being provided with a handwheel by which the press can be easily turned over while tools are being set up. The driving pulley is of the friction type and operated by a lever which is conveniently located for the operator. A separate friction operated by the same lever is used to overcome the momentum of the machine and bring it to a stop after the power has been shut off.

## STANDISH DRILL SOCKET

The Standish Tool Works, Inc., Sebago Lake, Maine, has recently improved the duplex drill socket of its manufacture by splitting the end of the collet in which the drill is held, and providing a knurled nut which fits the tapered threaded end of the collet and is screwed up to hold the drill. For the benefit of those who are not already familiar with this tool, it may be stated that it is particularly adapted for use in connection with the Standish double-end drill, the drill being driven by two tool steel pins that fit into the flutes. In this



Improved Standish Drill Socket

way the tendency to break the drill by twisting off the tang is overcome. These sockets have also been found useful for using up ordinary drills on which the tangs have been broken.

The collet in which the drill is held fits into a socket, a semicircular extension on the collet engaging a corresponding member in the upper end of the socket. The collet is held in place in the socket by a large safety set-screw. As the semicircular extension on the collet which does the driving is several times larger than the tang on a drill of the same size, ample strength is provided. These sockets are made of any desired taper number, and in three different sizes. The Standish Tool Works is also in a position to furnish bars of twisted high-speed steel from which drills can be made.

## KELSEY NUMBERING STENCIL

Duane J. Kelsey, 411 Y. M. C. A. Bldg., New Haven, Conn., has recently added to his line of draftsmen's instruments and drafting-room equipments, a transparent celluloid stencil for use in outlining numbers on a drawing preparatory to inking them in. It will be seen that the stencil contains all numbers, and by sliding it along the edge of the T-square, any

Kelsey Transparent Celluloid Stencil for outlining Numbers on Drawings

desired combination may be secured. The use of this stencil enables good looking numbers to be put on a drawing with great rapidity.

## HAUCK KEROSENE TORCH

There are many shops which have work for which a portable heating torch could be advantageously employed, but where conditions are such that the fire regulations prohibit the use of gasoline. With the primary object of overcoming this prohibition, the Hauck Mfg. Co., 140 Livingston St., Brooklyn, N. Y., has recently developed a torch which is adapted for burning kerosene in place of gasoline. The general design is the same as that of a gasoline torch, the usual form of air pump being employed to apply pressure above the oil and force it up to the burner. But as kerosene is less volatile than gasoline, it was found necessary to make the drip cup and burner larger, to have the burner heavier and to provide a longer duct through which the kerosene passes through the heated burner before reaching the needle valve. The larger supply of oil in the drip cup and the provision of this extended passage in which the kerosene is heated, provides for vaporizing it ready to be burned at the needle valve.

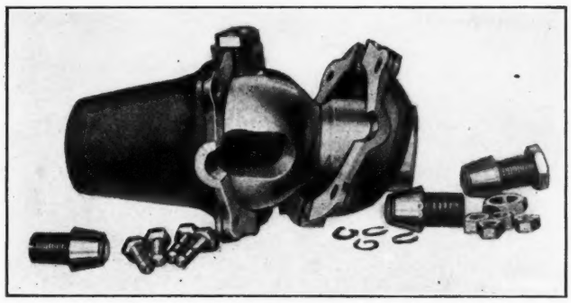
Hauck Portable Kerosene Torch

The use of kerosene in place of gasoline has several features to commend it. In the first place, kerosene can be bought almost anywhere, so that when these torches are being used outside the shop it is usually an easy matter to secure a fresh supply of oil. Furthermore, kerosene lasts longer than gasoline, possesses a higher number of heat units and is also cheaper than gasoline, so that a three-fold economy is secured through its use. The higher heating value of kerosene gives the torch in which this fuel is used a greater capacity, thus allowing it to handle heavier work. In using this kerosene torch out of doors, satisfactory service can be obtained in the highest wind or on the coldest winter days. The construction is very simple and the flame may be easily regulated by means of a special needle valve. The flame is guaranteed not to smoke or deposit soot on the work.

## ROLLER BEARING UNIVERSAL JOINT

An improved form of universal joint made by the Universal Machine Co., Bowling Green, Ohio, is illustrated herewith. It will be seen that this consists of a ball and socket joint which takes care of the up and down motion, the end thrust and all other strains, while four roller bearings

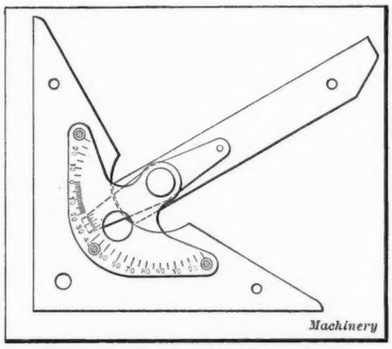
mounted on pins carry the driving torque. The wearing surfaces of the joint are hardened and ground. These joints were recently tested in the laboratories of the Ohio State University, and pronounced perfectly universal with neither "lag" nor "catch-up." It is necessary to grease the joint at infrequent intervals and only a few minutes are required for greasing. Centrifugal force distributes the grease to the required joints. These universal joints are finding application in automobile work and are adapted for various other classes of service.



Universal Machine Co.'s Roller Bearing Universal Joint

## KELSEY COMBINATION SQUARE AND PROTRACTOR

In nearly all classes of mechanical drafting, it is required to draw lines at various angles in addition to those which are available with the 30-60 and 45 degree triangles. For this purpose, two triangles and a protractor are customarily used. With the view of reducing the number of instruments which a draftsman must have on his board, Duane J. Kelsey, 411 Y. M. C. A. Bldg., New Haven, Conn., has recently developed the combination square and protractor illustrated herewith. It will be seen that this consists of a celluloid square with which angles of 30, 60 and 90 degrees can be drawn.




Kelsey Combination 30-60 Degree Square and Protractor

In addition, there is an adjustable blade which may be set by means of the protractor scale to draw lines at any required angle. The ruling blade has an extension which projects under a transparent plate that supports the bushing for the swivel pin. The protractor scale is graduated on the under side of this plate and in order to set the instrument for ruling a line at any required angle, the binder nut is loosened, after which the blade is swung to bring the index on the extension into coincidence with the required graduation on the protractor scale. The binder nut is then tightened. The extension on the ruling blade is provided with a vernier which enables settings to be made within a limit of accuracy of 10 minutes.

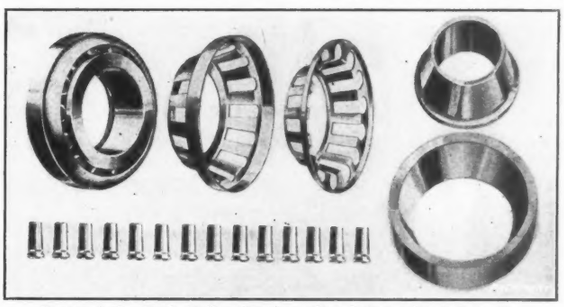
A simpler form of this instrument is also made, which is not provided with the extension and vernier scale on the ruling blade. In this case, there is a central line down the blade which passes through the axis about which the blade is pivoted. To set the instrument, this line is brought into alignment with the required graduation on the protractor scale, which is graduated on the under side of the square that forms the body of the instrument. A slot is cut in the ruling blade of this type of instrument, to enable the blade to be used as an erasing shield.

## BOCK ROLLER BEARING

The application of worm gears or spiral bevel gears results in the introduction of a thrust load. In automobile transmissions and in other geared drives where smooth, quiet running is essential, it is necessary for this thrust load to be supported by an anti-friction bearing. Those who are familiar with the extreme accuracy which is necessary in gearing for such classes of service will realize that the least wear or inaccuracy in the bearings results in the introduction of errors which more than offset the refinements of modern gear cutting practice.

To meet the requirements of such classes of service, the Bock Bearing Co., Toledo, Ohio, has recently perfected a roller bearing which combines the features of the tapered roller and the ball thrust bearing. The rollers employed in this bearing are of the usual tapered form but have a head at the large end which engages the cone flange. The running surface of this head is spherical and the contact is in direct line with the bearing surface of the roller. As a result, the Bock bearing is said to run without slippage or consequent wear. In addition to its capacity for carrying thrust loads, this bearing has a very satisfactory capacity for sustaining radial loads.

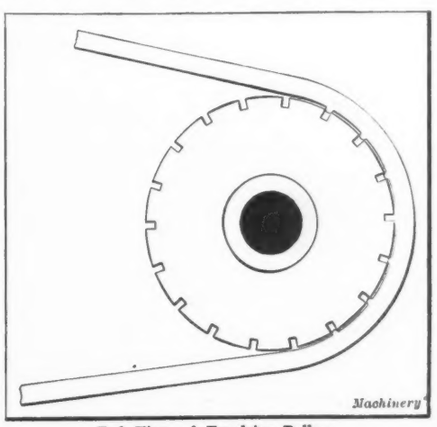
The accompanying illustration shows the parts of a bearing after it had been running continuously for 100,000,000 revolutions at 2050 revolutions per minute, under a thrust load of 1000 pounds. For three days of this time the bearing was subjected to a thrust load of 3000 pounds. After this severe test it is said that none of the bearing parts showed any wear. This result demonstrates the advantage of the Bock bearing for use in connection with worm gears or spiral bevel gears where it is absolutely necessary for the gears to be held in perfect running position in order to avoid wear. In this connection it may be mentioned that the bearings can be adjusted very tight so that lost motion is eliminated.



Parts of the Bock Roller Bearing after being subjected to the 100,000,000 Revolution Test

## EXCELSIOR PULLEY

In bending a leather belt over a pulley—particularly if the pulley is of small diameter—there is a tendency for compression ridges to form on the side of the belt nearest the pulley. This reduces the area of the surface of contact between the pulley and the belt, causing the belt to slip and reducing the transmission efficiency. Another cause which contributes to a reduction of efficiency is the "trapping" of air between belt and pulley.




End View of Excelsior Pulley

With a view of overcoming these difficulties, the Excelsior Pulley Co., Cuba, N. Y. has brought out a line of Premier wooden pulleys which are at present being made in sizes from 3 to 14 inches in diameter. Referring to the illustration it will be seen that there are grooves in the face of these pulleys which are said to serve the double purpose of taking up the

compression ridges in the belt, and preventing air being held between the pulley and the belt. As a result, it is claimed that the transmission efficiency obtained is 50 per cent higher than with a plain wooden pulley.

## NEWTON SAW AND ROTARY PLANERS

The Newton Machine Tool Works, Inc., Philadelphia, Pa., recently furnished the Bureau of Standards, Washington, D. C., with a cold sawing machine for use in preparing samples for test purposes. This machine, which is illustrated in Fig. 1, is equipped with a blade 32 inches in diameter. The capacity is for miter cuts on structural steel up to and including a 30-inch I-beam held flat on the top table; and for square or miter cuts on sections up to a 24-inch I-beam, when held in a vertical position on the bottom table. Stock up to round sections 9½ inches in diameter can be cut in a single operation, and larger stock may be cut by turning the bar. This machine can be converted into a rotary planer, as shown in Fig. 3, by removing the long table mounted on the shears and the clamping yoke and auxiliary parts of the main work-table. It will be seen that the main work-table has hand in and out adjustment for use in regulating the work for the length to be cut off when sawing or for the depth of cut when the machine is used as a rotary planer.

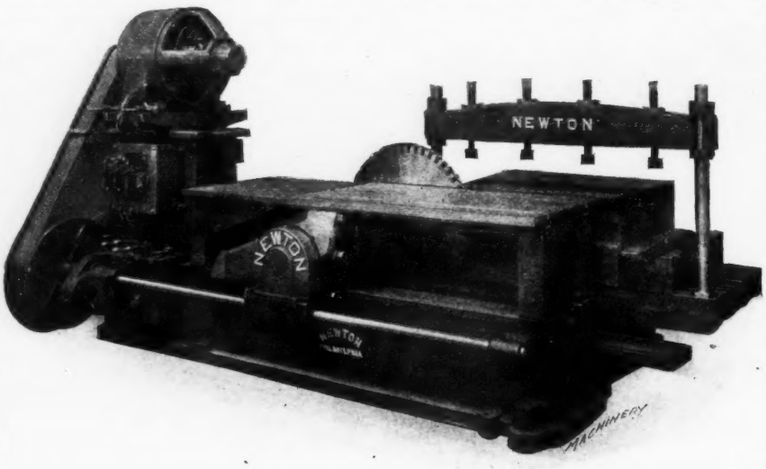



Fig. 1. Newton 32-inch Cold Saw built for the Bureau of Standards, Washington, D. C.

The drive is from a General Electric variable speed motor which is belted to the main driving shaft. It will be noticed that guards are provided over the belt to provide for the safety of the operator. The saw saddle has underlocking gibs which are cast integral with its base, and vertical and horizontal adjustments are made by means of tapered shoes. The feed is obtained through a gear-box which gives six changes without the removal of gears, the different feed combinations being obtained by sliding the sleeves on which different groups of gears are mounted. Provision is made for releasing the feed at any predetermined point to enable duplicate cuts to be made. It is also possible to release the feed automatically and engage the power quick return, or *vice versa*.

Another form of Newton rotary planer is illustrated in Fig. 2. These rotary planing machines were originally developed for finishing the bases of columns and other structural shapes, but their rate of production was found so satisfactory that they are now being applied on various other classes of work. It will be seen that the machine is driven by an individual motor belted to the driving shaft, the motor in this case being mounted on the saddle with which it travels. Working in the manufacturer's shops, this machine finished an iron casting 20 inches wide with the saddle advanced at the rate of 6 inches per minute, the depth of cut being ¼ inch.

The cutter head is a steel casting surrounded by a steel band into which the tool clamping screws are fitted. The drive to the head is transmitted through internal gearing, the teeth of which are cut from solid metal at the back of the head. Six changes of feed are provided through a gear-box of the same type as that on the machine shown in Figs. 1 and 3. It will be seen that the table is of the fixed type, the depth of cut being controlled by adjusting the spindle saddle. Only three control levers are employed. A single lever controls the feed and the rapid power traverse, the arrangement being such that it is impossible to engage both mechanisms at the same time. The handwheel controls the in and out adjustment of the spindle saddle for regulating the depth of cut.

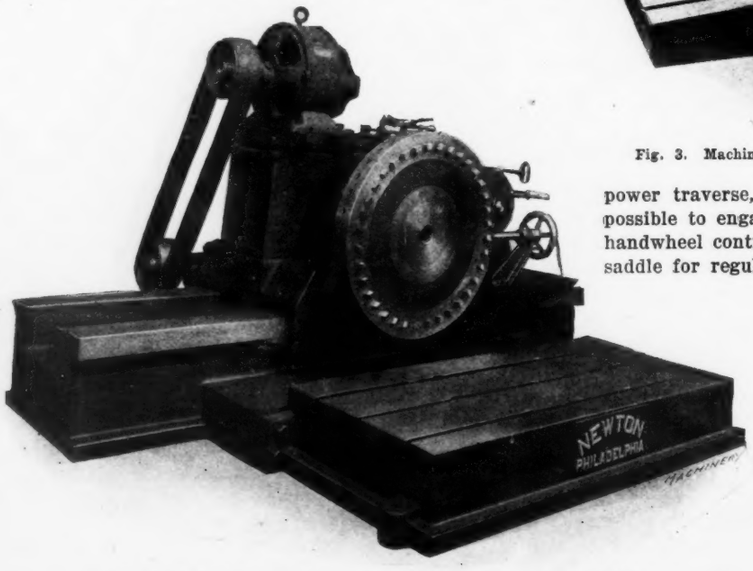



Fig. 2. Newton Rotary Planer with Motor mounted on Cutter Saddle

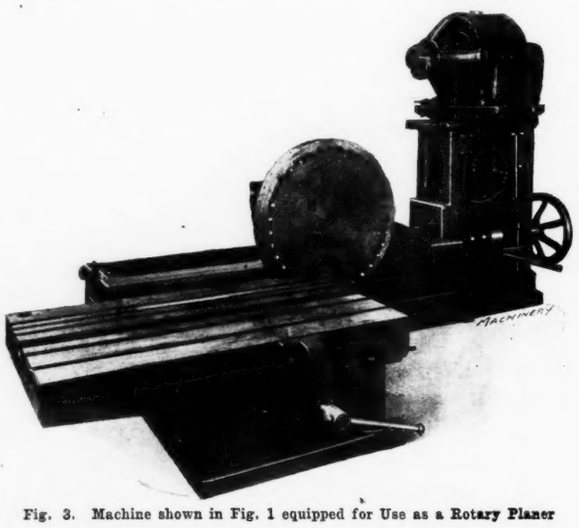


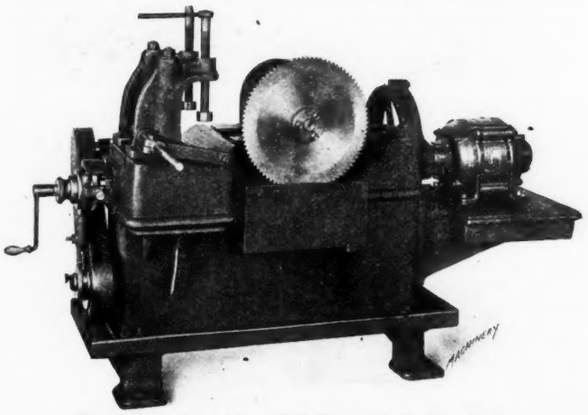

Fig. 3. Machine shown in Fig. 1 equipped for Use as a Rotary Planer

## BURR NO. 2 COLD SAW

The No. 2 cold saw described in the following is a product of John T. Burr & Son, 429 Kent Ave., Brooklyn, N. Y. It is equipped with an alloy steel saw-blade 14 inches in diameter, and will cut up to 5-inch round or 4-inch square stock. The vise arches are removable and such work as small beams and other sections may be clamped to the table by means of straps and bolts.

For some years this company has been

making a No. 2 cold saw of similar design, the improvements of the present machine consisting of the application of individual motor drive and a positive feed mechanism. The drive consists of a splined rod running parallel to the bed, on which a steel worm is carried. The worm is provided with



Burr No. 2 Motor-driven Cold Saw with Positive Feed

a ball thrust bearing, and meshes with a bronze rimmed worm-wheel, from which power is transmitted through a pair of steel gears to the saw arbor. The feed is transmitted through a screw actuated by ratchet and double pawls, either one or both of which may be employed. The travel of the pawls is varied by changing the pin in the double eccentric which is driven from the side shaft through a chain and sprocket. The feed is engaged by simply throwing in the clutch, and is automatically disengaged at the end of the carriage traverse.

## NIAGARA HEAVY BEADING MACHINE

The accompanying illustrations show a machine designed and built by the Niagara Machine & Tool Works, Buffalo, N. Y., for the purpose of performing beading, swaging and similar operations along the edges of sheet metal. The machine is particularly intended for use in factories engaged in the manufacture of automobile bodies, steel barrels and other sheet metal products. A novel feature of the design consists of the belt-driven raising and lowering device for the upper main shaft. The clutch pulley *A* drives a worm and worm-wheel by means of bevel and spur gears, the worm-wheel being keyed to the shaft *B* which carries on each end an eccentric and adjustable pitman which are pivoted to the upper

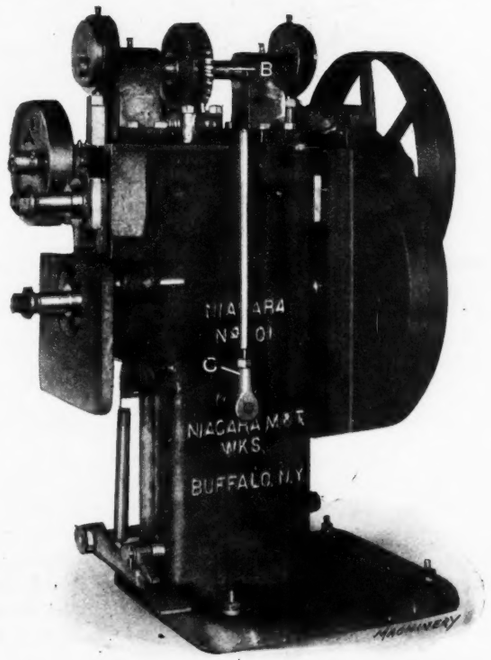



Fig. 1. Niagara Heavy Beading and Swaging Machine

main shaft bearings. The motion is controlled by the hand lever *C* to enable the operator to start and stop the upper shaft in any position. This is a very important feature, as it is frequently necessary to engage the work gradually or to hold the upper shaft in a specified position while the beading and swaging operations take place.

The worm which transmits the motion from the driving pulley runs in an oil chamber and anti-friction bearings are provided to take up the end thrust. The main shaft is driven from a clutch pulley controlled by a foot treadle, and gears on the two main shafts are always kept in proper mesh with each other. The operating lever for the shaft raising device and the clutch treadle are located in front of the machine in convenient positions for the operator. The principal dimensions of the machine are as follows: Diameter of main shaft, 2½ inches; minimum distance between shafts, 6 inches; maximum distance between shafts, 8 inches; ratio of gearing, 1 to 7½; and weight, about 1600 pounds. The working parts and gages for use in connection with this machine are made

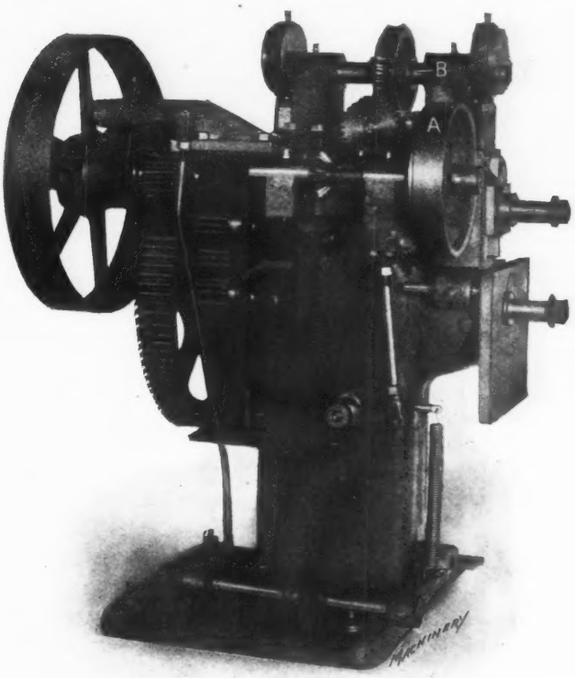



Fig. 2. Opposite Side of Niagara Machine shown in Fig. 1

to suit the particular requirements of the work on which it is to be used.

## HENDEY NO. 5 LINCOLN MILLER

The Lincoln type milling machine which forms the subject of this article is a recent addition to the line of machines built by the Hendey Machine Co., Torrington, Conn. This machine is particularly adapted for milling bridge reamers, and it will be seen that a double or elevating table is provided, the top section of which is pivoted at the rear end and rises and falls between substantial guides which are cast integral with the lower half or slide, at the front. Provision is made for bolting suitable cams or forms to the side of the table which engage with a roller carried by a bracket bolted to the face of the saddle. These cams are formed and applied in a way which allows for continuous fluting of reamers having both initial and secondary tapers, or a tapered leader and straight body.

The eight spindle centers shown in place on the table of the machine are indexed simultaneously, making a very efficient equipment for handling the classes of work for which this machine is intended. These centers swing 1½ inch and the spindles in the headstock are fitted with centers and coupling drivers adapted for holding the tangs of Morse No. 2 and No. 3 tapered shanks. The ratchet index plate is drilled for twelve holes, giving 2, 3, 4, 6 and 12 divisions; and other

divisional rows of holes can be drilled if desired. The footstock centers are provided with spring tension and lever release, while the binding plugs for the centers are operated by two handles on each side of the block.

Spring chucks may be provided for holding the ends of pinion shafts and similar work, thus enabling it to be handled in multiple. These chucks have a maximum capacity

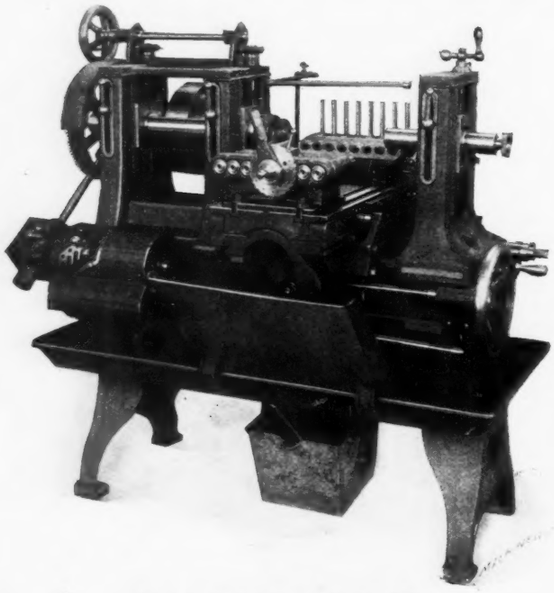


Fig. 1. Hendey No. 5 Lincoln Miller

of ⅞ inch. When the spring chucks are used, the headstock is fitted with special binding plugs controlled by two levers, each of which binds four spindles through the action of two plugs and a connection compression block. Head- and tailstocks of similar design can be provided with four centers if

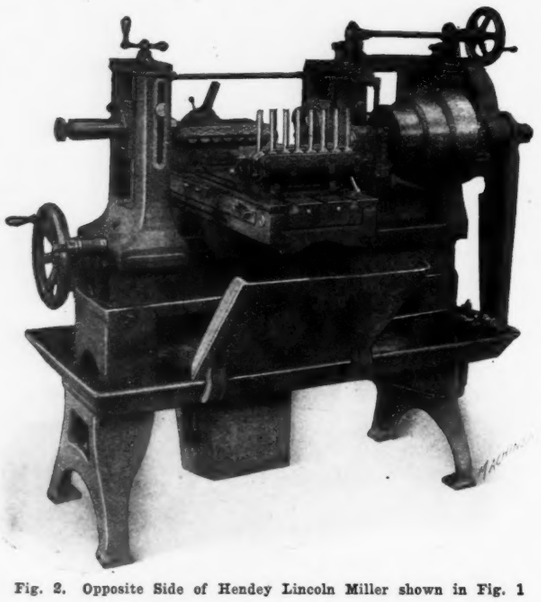


Fig. 2. Opposite Side of Hendey Lincoln Miller shown in Fig. 1

such equipment is better suited to the requirements of the work which is to be handled.

## KEMPSMITH TRIPLE INDEX CENTERS

For use in cutting small ratchet wheels, spur gears, rotary pump cams and similar parts which can be mounted on mandrels, the Kempsmith Mfg. Co., Milwaukee, Wis., has recently designed and placed on the market a set of triple index centers. The three spindles of this attachment are indexed simultaneously and all of the spindles are clamped at the

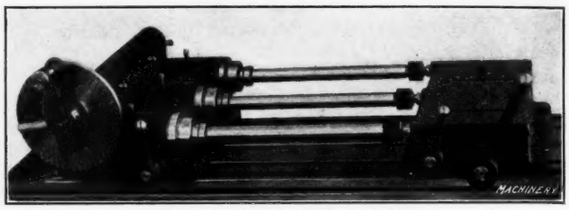


Fig. 1. Kempsmith Triple Index Centers

same time by means of the lever shown at the lower right-hand side of the headstock. Each spindle has a No. 10 Brown & Sharpe taper hole at the front end and a hole 1 inch in diameter extending through the spindle. A ⅝-inch draw-in bolt in each spindle provides for holding the mandrel firmly in place. The index plate and crank used on this attachment are the same as those furnished with the Kempsmith universal dividing head, and all numbers up to 60, all even numbers and multiples of 5 up to 120, can be obtained, in addition to many other divisions up to 300. The total number of divisions obtainable with these index centers is 195, and a chart showing how each different number of divisions is obtained is furnished with the index centers.

The tailstock is of an improved quick-acting type with the centers held in place by coiled springs. In withdrawing the centers from the work-holding mandrels, the entire tailstock is moved back, thus releasing all three centers at the same time. Conversely, when the work has been set in place, the

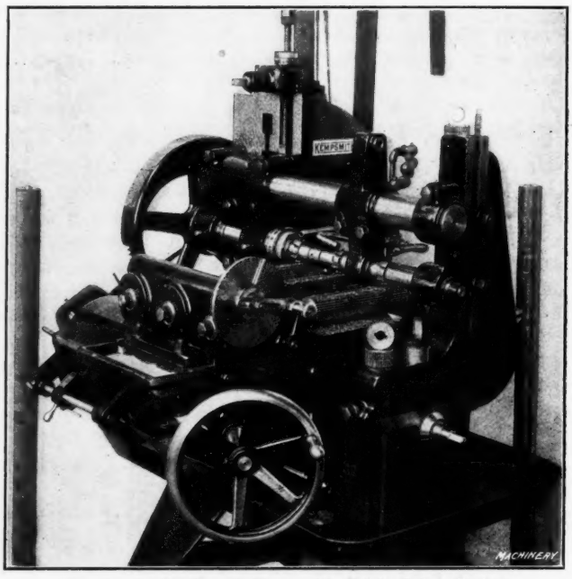


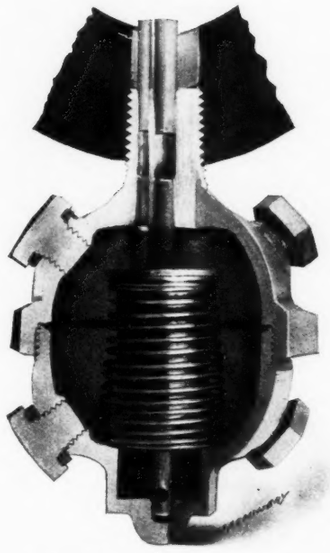
Fig. 2. Application of Kempsmith Triple Index Centers

tailstock is moved forward and locked in position by means of the right-hand lever. The steel centers are then clamped by means of the left-hand lever. Any inequality in the length of the work-holding mandrels is automatically compensated for by the coiled springs which adjust the positions of the centers independently of one another. The principal dimensions of this set of triple index centers are as follows: Center distance of mandrels, 6¼ inches, and distance from center lines of mandrel to table, 3¼ inches.

## BIGGAR BROS. "OIL FIRST" OILER

The oil cup which forms the subject of this article is particularly adapted for use on loose pulleys, and the principle of operation is such that a sufficient supply of oil is delivered to the bearing at the time the pulley starts to revolve, to keep it properly lubricated. While the pulley is in movement, the admission of any more oil to the bearing is prevented through the action of centrifugal force, but when the pulley stops and is again started, another supply of oil is delivered to the bearing.

The oiler can be filled in any position of the pulley by un-

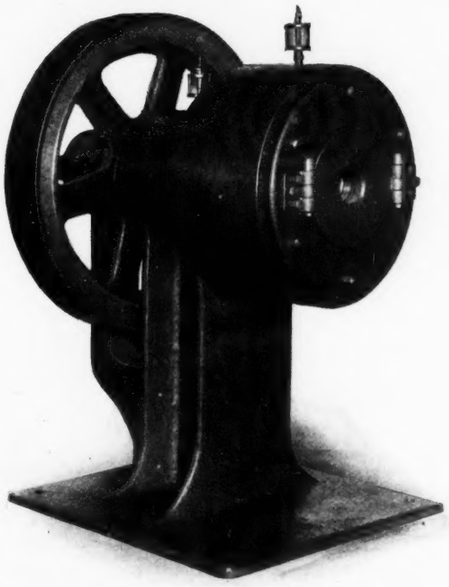


Biggar Bros. Loose Pulley Oiler

screwing either of the hexagon headed plugs. These plugs can easily be turned with the fingers without requiring the use of a wrench. The oiler is made of aluminum and is so light that it is unnecessary to provide a counterbalance on the pulley. There is no waste or leakage of oil. The method of operation is as follows: When the pulley starts to rotate, centrifugal force causes the oil to move out to the part of the oiler farthest away from the hub of the pulley. This fills the small cylinder with oil, and at the same time centrifugal force causes the plunger which works in this cylinder to move toward the head of the cylinder. The oil is thus compressed and a suitable supply for lubricating the bearing is forced down through the tube which runs from the cylinder to the bearing. It will be seen that there is a second tube in the threaded stem of the oiler which screws into the hub of the pulley. This second tube is to allow the oil to flow into the bearing and displace a corresponding volume of air which would otherwise prevent the oil from entering. This oiler is a recent product of Biggar Bros., Oneida, N. Y.

## ETNA SWAGING MACHINE

A machine for swaging tubing up to 4 inches in diameter is the latest product of the Etna Machine Co., Maplewood Ave. and Castle Boulevard, Toledo, Ohio. It will be evident from the illustration that this machine is of exceptionally rigid construction, and this, combined with the design of the swaging mechanism, enables it to handle large work at a very satisfactory rate. The flywheel, which is 36 inches in diameter and carries a 5-inch belt, is supported between two large bearings which are bronze bushed and insure keeping the shaft in proper alignment. The shaft is 6½ inches in diameter and the bearings are 44 inches long. Sight-feed lubricators keep the bearings properly oiled.

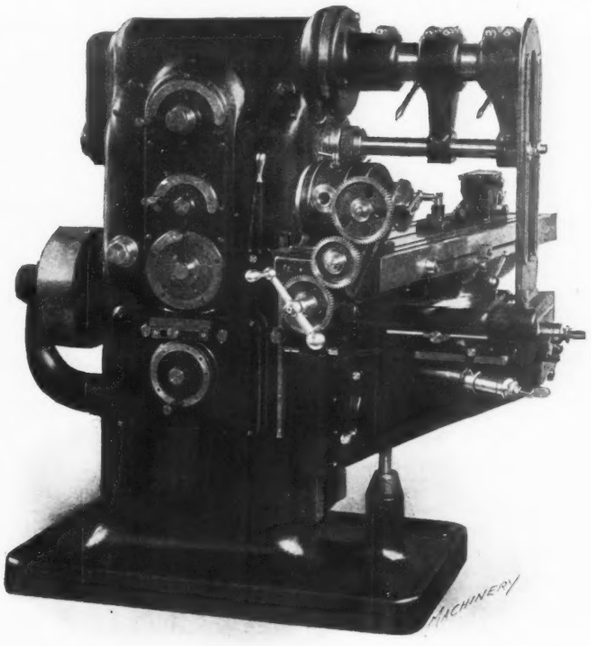


Large Etna Swaging Machine

## ROCKFORD NO. 2 UNIVERSAL MILLER

The latest addition to the line of milling machines built by the Rockford Milling Machine Co., Rockford, Ill., consists of the heavy all-geared No. 2 universal miller which is illustrated herewith. It will be seen that this machine has single pulley drive so that it may be belted to the lineshaft without requiring a countershaft to be used. The driving pulley is 16 inches in diameter, carries a 4-inch double belt and should be driven at 325 revolutions per minute. When individual motor drive is employed, a 5-horsepower motor is recommended. The spindle is made of crucible steel and accurately ground to size; it runs in bronze-bushed bearings which are provided with means for taking up the wear of both bearings at a single operation. There is a No. 11 Brown & Sharpe taper hole at the front end of the spindle, and the hole extending through the spindle is 1 inch in diameter, a draw-in rod being provided. Sixteen changes of spindle speed are available, these changes being in geometrical progression and covering a range from 15 to 376 revolutions per minute.

The feeds are all automatic and positive, the maximum movements of the table in the three directions being 28, 8 and 19 inches, respectively. The overhanging arm is 4 inches in diameter and made of solid steel, the patented flange support used on other Rockford machines being employed in this



Rockford All-geared No. 2 Heavy Universal Miller

case. Having the over-arm bolted to a seat on the column in this way provides greater stiffness and reduces vibration, thus increasing the cutting capacity. The distance from the center of the spindle to the under side of the overhanging arm is 7 inches. Two bronze-bushed arbor supports are supplied. The table is of exceptional depth to prevent the possibility of its springing when clamping heavy pieces of work in place. The working surface of the table is 50 by 11½ inches, and three T-slots ⅜ inch in width are machined in the table, in addition to oil grooves at the sides and oil pockets at the ends. The spiral dividing head swings 10½ inches and the spindle has a 1-inch hole extending right through it with a No. 11 Brown & Sharpe taper hole. The nose of the spindle is threaded to receive a chuck, and the spindle can be set in any position from 10 degrees beyond the vertical to 10 degrees below the horizontal. The swivel vise is graduated in degrees; the jaws are 6 inches wide by 1⅝ inch deep, and the vise is opened 3½ inches.

All shafts, with the exception of the main spindle, run in high-duty Hyatt roller bearings which are self-oiled; and all shafts are hardened and ground to size. If so desired, an automatic pump can be provided, together with a system of

return piping for carrying the lubricant back to the reservoir. The equipment furnished with the machine includes the spiral dividing head, a set of centers, index plates, change gears, a 6-inch three-jawed universal chuck, a swivel vise, a 1-inch arbor and all necessary wrenches. The net weight of the machine is 4200 pounds.

## SPRINGFIELD SINGLE-PULLEY LATHE

To meet the demand for a high-power lathe equipped with rapid change gears, the Springfield Machine Tool Co., 631 Southern Ave., Springfield, Ohio, has added to its line a 14-inch by 6-foot machine which is illustrated herewith. The design and method of operation are simple, and provision is made for securing the correct speed for all classes of work for which the machine is adapted. The drive is direct from the lineshaft to a single friction clutch pulley, and this arrangement makes the application of individual motor drive a simple matter. Owing to the fact that all journals, with the exception of the main spindle journals, are equipped with ball bearings, a high degree of transmission efficiency is obtained.

Twelve speeds which are in geometrical progression, are obtained in the geared headstock. The power is transmitted through the least possible number of gears, no gears being engaged which are not actually required in the drive. Any speed may be obtained direct without the necessity of passing through a series of speed changes to reach the correct one. The entire head mechanism is enclosed in an oil-tight case; the gears run in an oil bath and the bearings are lubricated by a constant stream of oil. The main spindle bearings are supplied with sight-feed oilers which provide a liberal supply of clean oil.

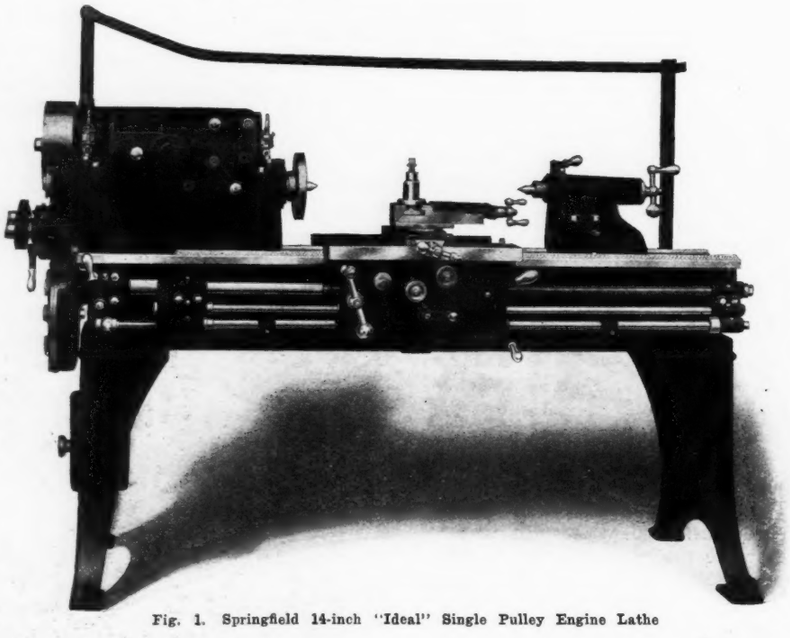


Fig. 1. Springfield 14-inch "Ideal" Single Pulley Engine Lathe

The clutch pulley is located at the rear of the head and the friction clutch is operated by a push-rod which allows the lathe to be started or stopped instantly. If desired, the head can be furnished with reversible drive; and the position of the clutch pulley places the belt out of the operator's way. Where individual motor drive is employed, the motor may be placed in any position—on the floor, ceiling, at the back of the lathe or on the top of the head. All operating levers are located at the front where they are readily accessible.

* * *

The American Consulate in Moscow, Russia, has cabled to the Government in Washington that reduced freight rates will be granted to American importers via Vladivostok, according to the *Daily Consular and Trade Reports*. For further information address Bureau of Commerce and Labor, Washington, D. C.

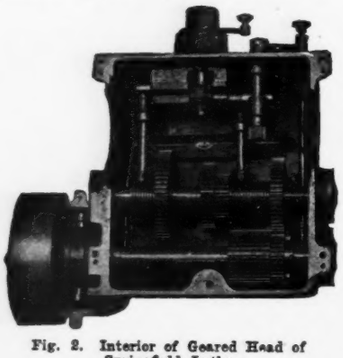


Fig. 2. Interior of Geared Head of Springfield Lathe

## NEW MACHINERY AND TOOLS NOTES

**Combination Pocket Rule and Level:** Lufkin Rule Co., Saginaw, Mich. A two-foot folding box-wood rule fitted with a spirit level.

**Power Press Clutch:** Bauroth Machine & Stamping Co., Toledo, Ohio. A safety clutch which is now being applied to the entire line of power presses manufactured by this company.

**Steel Pulley:** Oakes Pressed Steel Co., Indianapolis, Ind. A pressed steel pulley with a piece of tubing brazed at the center, which provides sufficient material to enable a key-way to be cut in the hub.

**Taps:** Winter Bros. Co., Wrentham, Mass. Two styles of taps, one of which has two, and one three flutes and lands. The claim is made that these taps are more effective for working in steel than taps made with four flutes.

**Adjustable Strap Support:** Henry Perkins Co., Bridgewater, Mass. A strap support made in two styles, each style being made in three sizes. One style of strap is plain, while the other is provided with a locking device.

**Slot Milling Machine:** Newton Machine Tool Works, Inc., Philadelphia, Pa. A machine for use in electrical manufacturing plants, for milling the dovetail slots for the laminations in the rotors and frames of electrical machines.

**Grinding Machine Chuck:** Diamond Machine Co., Providence, R. I. A work holding attachment for use in connection with the face grinding machine built by this company. This is intended for handling circular work such as piston rings, pipe flanges, etc.

**Polishing Machine:** Challenge Machine Co., Philadelphia, Pa. A polishing machine equipped with a double-end spindle. The lead may be set up on the bench or mounted on a column, according to the requirements of the shop in which the machine is to be used.

**Flexible Shaft:** United Mfg. Co., Kansas City, Mo. A flexible shaft built up of alternate links of steel and bronze. Each link is provided with a circular flange which affords a bearing against the casing. The flexible outer casing is made of steel and is oil-tight.

**Tube Swaging Machine:** Langelier Mfg. Co., Providence, R. I. A special machine built by this company for swaging small sizes of tubing with walls 0.0393 inch thick. The tubes to be swaged have a taper at two sections and they are formed over a suitable mandrel.

**Flexible Coupling:** Clark Flexible Coupling Co., 90 West St., New York City. This coupling consists of two hubs with sprocket teeth cut in them to provide for flexible connection by means of a roller chain. By this means ample adjustment is provided to compensate for errors in alignment.

**Roll Turning Lathe:** United Engineering & Foundry Co., Pittsburg, Pa. A heavy-duty machine built in sizes ranging from 18 to 50 inches swing. The machines

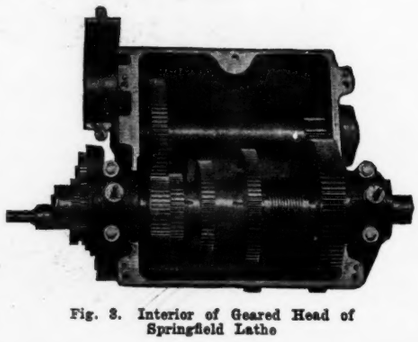


Fig. 3. Interior of Geared Head of Springfield Lathe

are motor-driven, and provided with means for making speed adjustments. When so desired they may also be equipped for belt drive.

**Punch Press Guard:** Southern Stamping & Mfg. Co., Nashville, Tenn. A press guard consisting of a gate which drops down in front of the die. When the gate is raised to place work in the die, it is impossible to trip the press, it being necessary to first lower the gate into contact with the bed.

**Adjustable Bearing:** Stow Mfg. Co., Binghamton, N. Y. This company has recently applied an adjustable bearing in the motor cases of its electric center grinders. This consists of a split bushing which is assembled in the bracket of the motor case, and adjusted to provide the required running fit.

**Turbine Bucket Miller:** Newton Machine Tool Works, Inc., Philadelphia, Pa. A duplex milling machine built for the purpose of finishing turbine buckets. The machine is equipped with two horizontal spindles, each of which has means of adjusting to regulate the depth of cut. Each spindle is mounted in an independent saddle.

**Twist Drill Grinder:** Automatic Twist Drill Co., Cincinnati, Ohio. A machine for grinding twist drills ranging from 5/16 to 2 inches in size. It is claimed that this machine will hold a two-, three- or four-lipped twist drill or a flat twisted drill in the correct position for grinding. The drill is revolved at a uniform speed while being ground.

**Motor Starters:** Allen-Bradley Co., Milwaukee, Wis. Starters for use in connection with large direct-current motors ranging from 150 to 300 horsepower. These starters act on the compression principle. By compressing a series of graphite disks, the resistance of the circuit is varied to meet the requirements of different operating conditions.

**Swivel Vise for Hacksaw Machine:** Millers Falls Co., Millers Falls, Mass. In the August, 1914, number of MACHINERY the No. 90 power hacksaw of this company's manufacture was illustrated and described. Since that time the Millers Falls Co. has equipped this machine with a swivel vise to provide for cutting off work at any required angle.

**Electric Driven Truck:** Cowan Co., Holyoke, Mass. This consists of the regular type of transveyor manufactured by this company which is equipped with a storage battery and electric motor drive. The same type of auxiliary loading platforms are employed with this truck as are used in connection with the Cowan transveyor that has been previously described in MACHINERY.

**Duplex Milling Machine:** Rockford Milling Machine Co., Rockford, Ill. This machine consists of the No. 2 milling machine of this company's manufacture, equipped with a second cutter spindle carried in a bracket. The auxiliary spindle is opposed to the main spindle of the milling machine and driven through gearing from a shaft running through the overhanging arm.

**Semi-automatic Boring Mill:** Reed-Prentice Co., Worcester, Mass. A double-spindle semi-automatic vertical boring machine designed to do all the machining on the brake and transmission drums of the Ford automobile. Although designed for this particular purpose, this is not essentially a single-purpose machine, as the provision of proper tools would adapt it for handling a variety of other classes of work.

**Tapping Attachment:** Moline Tool Co., Moline, Ill. A light auxiliary table for use on the table- or rail-feed multiple drilling machines of this company's manufacture. The parts of such machines are necessarily made heavy with the result that they possess considerable inertia when in movement. This inertia may result in stripping the threads of small taps, and to overcome this difficulty the light auxiliary table is provided.

**Safeguard for Presses and Hammers:** H. C. Hart Mfg. Co., Unionville, Conn. This device consists of a strap resembling a glove with the fingers cut off. A chain fastened to the strap extends to a lever on the machine which is connected with a suitable train of mechanism to provide for drawing the operator's hand out of the "danger zone" before it is possible for the ram to descend. It is claimed that the use of this device does not reduce production in any way.

**Vertical Drafting Board:** Improved Drafting Board Co., Nashua, N. H. This board is suspended on a frame and is raised or lowered to bring the part of the drawing being worked on into a convenient position. The draftsman may either stand or sit in front of the board and is always in a comfortable position. The convenience of this arrangement will be readily appreciated by draftsmen who have occasion to work on large drawings held on a horizontal drafting table.

**Small Grinder and Attachments:** Union Twist Drill Co., Athol, Mass. A radial grinding machine for grinding convex or concave milling cutters. The use of this tool provides for grinding such cutters accurately and the capacity is for cutters of from 3 to 7 inches in diameter, with the radius of the curved teeth to be ground ranging from 1/16 to 2 inches. This company has also recently developed attachments for use in connection with the universal cutter and reamer grinder of its manufacture for use in grinding side-mills and end-mills.

**Multiple Spindle Drilling Machine:** Baush Machine Tool Co., 200 Wason Ave., Springfield, Mass. A machine built for drilling all the holes in an automobile transmission case without requiring the work to be reset. The holes are drilled regardless of their size, position or angle; and the design is such that each tool runs at the correct speed. Each spindle may be adjusted independently for drills of different lengths. The machine is equipped with three heads, one of which is vertical, and the other two horizontal and opposed to each other.

**Motor-driven or Single-pulley Lathe:** Bradford Machine Tool Co., Cincinnati, Ohio. In the November, 1913, number of MACHINERY, the 18-inch heavy pattern lathe of this company's manufacture was illustrated and described. Since that time machines of 26-, 28-, 30- and 32-inch capacity have been added to the line of lathes built by this company. These are adapted for either individual motor drive or single-pulley drive. A suitable speed range for the classes of work handled on machines of this capacity is provided by the gearing in the head, so that a standard motor can be employed.

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## NEW YORK ELECTRICAL EXPOSITION

The annual New York Electrical Exposition and Motor Show was held in the Grand Central Palace, New York City, October 7 to 17 inclusive. Over one hundred exhibitors showed a wide variety of electrical apparatus and applications of electricity for manufacturing, therapeutics and the home. The United States government gave three exhibits showing the minting of money, the manufacture of army rifle cartridges and naval apparatus. The mint exhibit comprised a complete section of the mint from the furnace for melting the metal to the massive coining press for impressing the designs on the coins. The manufacture of cartridges was shown in part only, but sufficient machinery was exhibited to give a fairly good idea of the process of making the shell, primer and nickel-jacketed bullets, to complete which requires eighty-three distinct operations.

The general exhibits filled three floors. On the third floor was a model garage equipped with the following machines and machinists' tools: Fay & Scott 32-inch extension bed gap lathe; Cincinnati No. 1½ universal milling machine; U. S. Electrical Tool Co.'s electric drills; Gould & Eberhardt shaper; Rockford Drilling Machine Co.'s upright drill; Cincinnati Pulley Machine Co.'s "Avey" sensitive drill; Union Twist Drill Co.'s milling cutters; S. W. Card Co.'s taps and dies; J. H. Williams & Co.'s wrenches, clamps and lathe dogs; Champion Blower & Forge Co.'s blacksmith drill and "Champion" forge. All of the machines were driven by individual electric motors.

The object of the exhibit is to make ocular demonstration of the many advantages and uses of electric power in the factory, shop and home for facilitating manufacture, making repairs and promoting home comforts. The section devoted to electro-therapeutics comprised a number of interesting exhibits useful to physicians, surgeons and dentists. A comparison of a carbon filament electric lamp made in the early days of incandescent electric lighting and one of the latest "Mazda" lamps showed something of the wonderful advance that has been made in electric lighting during the past thirty years.

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## FOREIGN ORDERS FOR MACHINE TOOLS

Many exaggerated statements have been current in regard to foreign government orders for machine tools placed with our manufacturers in October, one order for 1000 lathes being a favorite story. The facts as nearly as can be ascertained are that orders for about 1600 lathes in all were placed, principally for 14, 16 and 18 inches swing. One large Cincinnati concern obtained an order for 300, and an Eastern concern for 250. Besides these, orders have been received from a number of foreign dealers, probably also for government use. These orders were not confined altogether to lathes, but a few other machine tools were also called for. The total amount, figured conservatively, is between $800,000 and $1,000,000. These sales are very welcome to our manufacturers and have imparted a brighter aspect to the trade situation. They are undoubtedly the forerunner of future orders which will probably continue during the war and doubtless extend to other lines.

## NATIONAL MACHINE TOOL BUILDERS' ASSOCIATION CONVENTION

The thirteenth annual convention of the National Machine Tool Builders' Association was held at the Hotel Astor, New York City, October 22-23. William A. Viall of the Brown & Sharpe Mfg. Co. presided. Notwithstanding the general business depression and the dullness of the machine tool trade in particular, a fairly good representation of the association was present. The membership comprises 162 concerns and 126 names were registered, of which over 100 were accredited members.

President Viall, in his opening address, referred to the fact that the great and sudden changes caused by the European conflict have directed the attention of American manufacturers to the South American trade, and this is now receiving the attention it deserves. It will soon be apparent, however, that South American business is not waiting like over-ripe fruit to be plucked, but in order to secure the business of these countries close attention and careful study for long periods of time, and the establishment of American banking connections will be necessary. It was not the wish to take advantage over our friends in Europe engaged in a great war, but a plain duty lies before American manufacturers and it would be foolish and unwise not to take advantage of it. Reference was made to the agitation for higher railroad freight rates and the move to re-classify the freight ratings on some of the products of the members of the association. The belief was expressed that the members of the association are in accord with helping the railroads to get fair returns on their investments, and would not stand in the way of giving them proper compensation for services rendered.

C. Wood Walter of the Cincinnati Milling Machine Co., chairman of the legislative committee reported on legislation affecting the machine tool trade and membership. He spoke of the bill creating the federal trade commission, and the Clayton anti-trust law as undoubtedly being directed toward creating better social conditions, and therefore commendable. So far as could be seen by the chairman, these laws did not interfere with the customs of doing business as approved by the members of the association or with the aims of the association as a body.

S. H. Bullard of the Bullard Machine Tool Co., chairman of the catalogue committee, reported on the progress of the collective catalogue of machine tools and accessories which is to be printed in several languages. This catalogue has been under consideration for two or three years, and considerable preliminary work has been accomplished. The outbreak of the European war, however, has changed conditions, and in discussion, some doubt was voiced of the advisability of going ahead with the project now. The difficulties of distribution were touched on, and admitted to be serious.

W. H. Barr, president of the National Founders' Association, was given the privilege of the floor to call attention to a safety exhibit made by the National Affiliated Safety Organizations which embraces the safety work of the National Founders' Association, National Association of Manufacturers, National Metal Trades Association and National Electric Light Association. A movement is on foot to combine all organizations for promoting safety in shops, mills and factories in one common body (N. A. S. O.) and thus secure uniformity and standardization of practice with respect to signs, regulations and methods for promoting safety in manufacturing plants.

H. R. Eldredge, vice-president of the National City Bank, New York City, made an address on foreign trade, particularly South American trade, which was most interesting and inspiring. The National City Bank has established a branch in Buenos Aires and will open another branch soon in Rio de Janeiro. The functions of these branches were explained, showing how helpful American banking institutions can be to American commerce. It was pointed out that financing foreign enterprise was a great advantage to a nation because the supplies needed for the projects were invariably required to be purchased in the country furnishing the capital.

The second session, in the afternoon, was opened with a paper, "Reform in Drawings," by E. H. Fish, New England editor of the *American Machinist*. Mr. Fish touched on the practice of making drawings, the conventions in use and the lack of uniformity. It was unfortunate, in his opinion, that many draftsmen were too proud to make their drawings understandable by using the English language. Many men today are working in machine shops earning good wages, thanks to specialization, who have had no training whatsoever in reading drawings and therefore are unable to grasp the meanings of the common and uncommon conventions in use. These men, however, are able to understand English and wherever there is doubt of the meaning of a drawing or the possibility of a mistake, legends should be inserted to make the matter clear. The paper was illustrated with a number of sketches showing examples that have caused trouble even in shops where mechanics were used to reading drawings. The more liberal use of cross-section views was advocated.

Magnus W. Alexander of the General Electric Co., made an address, "Waste in Hiring and Discharging Men," which dealt with the enormous waste annually incurred by manufacturing plants in indiscriminate hiring and firing of help. It is extremely difficult to determine the exact costs of hiring and training an employe—in fact impossible, because of varying conditions. Mr. Alexander's figures indicated that the cost ranged all the way from $8.50 to $65 per individual, and estimates received from employers of labor in other plants than the General Electric with which Mr. Alexander is connected, were higher, ranging up to as much as $200 per man. One large concern, in an endeavor to increase its working force, hired 42,000 persons and out of that vast number secured a permanent increase of working force of only 7000. It was conceded that the waste could be greatly diminished if more care was exercised by the hiring department in selecting men suitable for jobs. A new man requires instruction and is often the cause of considerable damage to machinery and tools in the breaking-in process. It seems highly important to reduce this economic waste both from a purely business point of view and from a broader social standpoint.

The morning of the second day of the convention was given up to committee meetings comprising lathe, sensitive drilling machine, boring machine, gear cutting machine, grinding machine, hand screw machine, radial drilling machine, planing machine, milling machine, shaping machine, vertical drilling machine and turret lathe committees. In the afternoon, a number of resolutions were read by S. H. Reck of the Greaves-Klusman Tool Co., one of which put the association on record as favoring the requested advance of five per cent in freight rates for the eastern railroads. Another resolution was read, expressing sympathy with all the nations at war, and the hope that the war will come to a speedy end.

The members were favored with a long paper by James Logan of the United States Envelope Co., entitled "A Closer Commercial Relationship with Latin America." Mr. Logan sketched the conditions of life in the principal countries of South America and pointed out some of the difficulties in developing trade between the United States and the Latin-American people. The relations between these people and Europe are very close and in Mr. Logan's opinion, it will take years of hard, persistent work to secure a large trade. His views are based on the experiences gained in a trip with a party, with the view of extending commercial relations and securing acquaintances that would be helpful.

All the officers were re-elected as follows: President, William A. Viall, Brown & Sharpe Mfg. Co., Providence, R. I.; first vice-president, J. B. Doan, American Tool Works, Cincinnati, Ohio; second vice-president, D. M. Wright, Henry & Wright Mfg. Co., Hartford, Conn.; treasurer, A. E. Newton, Reed-Prentice Co., Worcester, Mass.; secretary, C. L. Taylor, Taylor & Fenn Co., Hartford, Conn. Charles L. Hildreth, Whitcomb-Blaisdell Machine Tool Co., Worcester, Mass., continues as general manager.

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The subscription price of $2.50 a year has been fixed for the *Daily Consular and Trade Reports* published by the Bureau of Foreign and Domestic Commerce, Department of Commerce, Washington, D. C. The new plan of distributing the reports, which became effective July 1, 1914, enables all firms and individuals who desire the publication to obtain it.

# REFORM IN DRAWINGS*

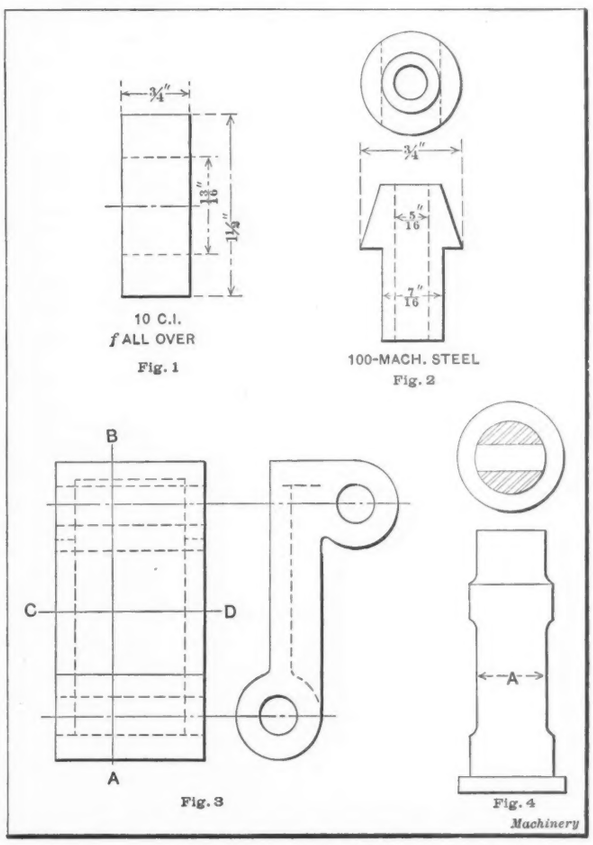
HOW TO MAKE DRAWINGS THAT GIVE THE SHOP ALL NECESSARY INFORMATION

ONE of the most prolific sources of inefficiency in a machine shop is its drawings. In one place the drafting room may dominate the shop, in another the shop may ignore the drafting room. The result is friction and loss. The object of this article is to see if there is any way by which this friction can be reduced with satisfaction to all concerned. A drawing may be said to be an order to the shop showing *what* to make; and a route sheet is an order *how* to make it. The drawing, however, should have one other and equally valuable function. It should be an accurate record of what *was* made. In order that it may perform all these functions, the man that makes the drawing must know what is going on in the shop. If his drawing is wrong in the slightest particular, or if the exigencies of the case call for changes, he should be notified at once in unmistakable terms, and there should be some way of checking his work to know if he has made the needed changes promptly.

Changes may not be reported to the drafting room for a number of reasons. The shop may have made a mistake and in order to save a casting or a string of castings, a change is made in another piece and no report is made because no one is anxious to own up to the mistake. The machinist may have been snubbed by the draftsman and he may be literally afraid to report an error, due to the imaginary advantage that an educated man has over an uneducated one. Draftsmen as a class are better educated than machinists. Too often the latter's lack in English results in the substitution of profanity for descriptive adjectives, and the outcome is that the man whose selection of adjectives is the better ordinarily wins even though his arguments may be altogether wrong. Consequently, the very first point of attack should be to give the machinist a better opinion of the draftsman by helping the draftsman to become better himself, and also by giving the draftsman a clearer idea of the machinist and his limitations. When a drawing is once made, even though we may have arranged for its correction if wrong, there are two possibilities that it may not be good for anything; one because the man who made it was incompetent or careless, the other because the system was wrong. Draftsmen come from all sorts of sources, but enough of them come from the technical schools so that the trade is dominated by them. The technical schools teach drawing today as they did years ago when machine shops were filled with men that had mechanical intelligence. Drawing has been called a universal language so long that we have come to believe that it is, while as a matter of fact there have been so many conventionalities introduced that its language is, like English, swallowed up in its slang. Anybody can start a new conventionality—there is no penalty—and there is hardly a shop that does not have some peculiarity that identifies its drawings. Even Brown & Sharpe give the number of threads per inch in Roman numerals. Hardly any other shop does but each has its own idiosyncracy.

While the route sheet is supposed to be the order *how* to do the work, and the drawing an order *what* to make, it is too much to ask of human nature that a man should make an intelligent order unless he knows how the thing will be made. This has been given as a reason for having the draftsman route his own work through the shop. Possibly the suggestion was based on the idea that if the draftsman found that that was part of his job, he would throw it up in favor of a man who was a machinist first and a draftsman second. It seems unlikely that we can get real satisfaction from a draftsman who has not in some way gotten a pretty clear idea of what is done in the shop at all stages of the work. Fortunately a few men can get this without actually working in the shop, but for almost every one it means two or three years of actual work. If the shop of a technical school is anything like a commercial shop it ought to be able to give men of the quality that attend a pretty fair insight into shop methods. If it is run on exercises that are twenty-five years behind present practice, it will have more trouble doing it. The fault with "tech" draftsmen is more apt to lie in their shop practice than in their drafting practice.

The technical graduate may have a hard time learning to make a neat drawing, but if his shop practice has been good he should soon be able to make a usable drawing. If he is not it is because he is not duly impressed with the idea that every error that he makes is multiplied by the number of pieces that are made before he is found out, and added to the cost of every preceding operation that has been performed on them. The first thing that the green "tech" man or any other draftsman should get firmly fixed in his mind is that the men in the shop are no longer mechanics exclusively, but that modern systems have made it possible to give employment at wages that compare favorably with those paid to mechanics, to a vast body of men who would otherwise be on the bread line. His drawings must be made so that these men can read them. It may be hard on the draftsman, but it is worse for the shop if the drawings are not made with the utmost possible clearness, for if this is not the case, the foreman must act as interpreter and waste time that he might spend to better advantage in other ways. Nor is it necessary for the draftsman to assume that because he has made his drawing clear and accurate there is nothing further for the shop to concern itself about. More improvements have originated in the shop than in the drafting room, and always will, even though our draftsmen may come from the shop, for in so doing they will lose their point of view and acquire another. Probably we have not demanded enough from the draftsman. We have accepted him much as we have the stenographer. We do not expect that stenographic




**Figs. 1 to 4. Examples of Drawings which fail to give Complete Instructions to the Machinist**

* Abstract of a paper read by E. H. Fish before the convention of the National Machine Tool Builders' Association at the Hotel Astor, New York City, October 22-23, 1914.

notes can be read, even by the next girl, and if a stenographer rises to the height of using the same technical expression that we dictated, we are surprised and gratified. The case is similar to that of the draftsman, who realizes plainly what he is attempting to delineate, and is prone to assume that every one else can read what is in his mind and what he forgets to put on paper. These "sins of omission" include necessary views, dimensions, and specification of material and finish wanted. The draftsman's chief "sin of commission" is the introduction of a cobweb of dotted lines that mean nothing without a drawing board and tee square with which to follow them across the drawing.

Fig. 1 shows a simple collar as the drawing is usually made. It seems like a pretty complete drawing; but, first of all, it is impossible to make ten of these collars that will be correct as dimensioned. We may happen to realize that our reamer is 0.001 inch under size, and we cannot afford to buy a new one for these ten collars, concerning the use of which we know nothing. So we send upstairs to know if it will do to have the holes 0.001 inch small. The reply comes back that if the hole is smooth it will be all right and as we have to make the shafts anyway they don't see why we care. So we know that 0.001 inch small in the hole will be all right but we do not know how much more would go. Then we look at the material; if it was only cold-rolled steel we could chop the things out on the screw machine in no time, but of course the pattern was made and the castings in the shop before we heard of the job. So we call up again and find the steel would be all right but they never heard of doing such a thing. Then we chase around for some steel and find that all we have is 1½ inch and 1¾ inch. Then we wonder why the outside needs to be 1½ inch, so we go up ourselves this time, and find that this outside diameter must fit snugly into the surrounding atmosphere, so that it will be all right if we use any size stock that we happen to have and just run a chip over it. By this time we know better because we got a glimpse of the assembly drawing and saw that this collar goes on a little shaft to which it is secured with a pin. The only jig we have for drilling pin holes in collars anywhere near this size takes a 1 7/16-inch collar. We get that changed and while we are there we try to find out how near to size the thickness must be and what character of finish it should have. It seems the thickness may vary 1/16 inch if necessary; and that the outside should be polished, with the corners neatly rounded, and the sides trued up square and left without polishing. In fact that is the only thing about the job that requires care. In this one simple piece we had the four chief "sins of omission": there were no limits given, the material was not given consideration from the shop point of view, the kind of finish was not specified, and no attention was paid to the use of tools already available.

Some draftsmen will tell you that there is such diversity of practice that they do not know what system to use. As to that you may very well tell them to take no chances that their drawings will be misunderstood. If there is no agreement as to conventionalities, drop them. If a drawing fails to express your meaning, try English. If you want a piece turned and ground to a mirror finish, say so without abbreviations. Don't simply say "f ALL OVER." If the piece is good enough, if it is simply rough-turned so that it will balance, say so and stop the machinist wasting time on it. If it must be in running balance, say so before anyone asks, or forgets to ask. Look over any drawing that has been sent out of the home shop and the number of notes penciled on it will give you an idea of the value of English to the machinist. Don't be so afraid to use your own language. Look at every drawing from the point of view of the man that wants to show you up, and find out what else he can make that the drawing will excuse. Fig. 2 shows a piece ¾ inch in diameter, flatted off on each side so as to be only 7/16 inch across. The drawing is correct but it is misleading in that there is no danger sign; it is as bad as a railroad crossing without a sign post. You are almost sure to get a hundred pieces with shanks 7/16 inch in diameter. This drawing needed another view, a bottom view with full lines only, and it needed a note to the effect that the sides are flat. Dotted lines are an invention of Satan, valuable to the man that made them because he has imagination, an attribute denied the rest of us. Take the case shown in Fig. 3; how can anyone guess what the dotted lines mean without a drawing board and T-square? A cross-section on *A B* and another on *C D* would have simplified matters, and machinists like cross-sections. So do other workmen. An architect uses little else except cross-sections for elevations; his floor plans and his details are all cross-sections. Don't be too literal. The tool-post, Fig. 4, is literally correct, but it is liable to be misunderstood and you may get a piece turned small at *A*. A cross-section added would fix things.

There are still many shops where limits are not used. We should not deceive ourselves about that. They turn out good work and lots of it but they cannot do it with the class of men with which the larger shops are being filled. They must hire machinists to do machine work, and they must fit each part to its place. In such a shop nothing has beaten the assembly drawing with dimensions. If a man gets an assembly drawing of a planer head, and what he is doing is turning the swivel, he knows at once that a considerable variation from size is allowable, and if the part is one of the miter gears he knows that its hub must fit freely enough so that if no one oils it for a year or two, it will not stick. The operative, working from a detail drawing, cannot be expected to know these things. He must make a piece or do his work on it and it must be inspected in the light of the orders which were given him. If he was told to grind a shaft with a tolerance of 0.001 inch either way, he can expect to have it accepted whether it fits or not, because it can be shown that the fault was in the hole rather than in his work. If no tolerances are established, then, of course, the draftsman is not to blame if he does not use them; the system or lack of system is to blame. Then there is the failure to consider the material from the standpoint of the shop as well as the finished product. While the shop may be expected to have the best information as to what it can make a thing out of in the least time, that information should be in the hands of the drafting room in as complete a form as possible. Likewise, information should be in the hands of the drafting room as to the limitations of the shop equipment. If a draftsman specifies a thread R 4⅝ diameter 5 pitch, when the nearest tap on hand is 4¾ diameter 4 pitch, there should at least be an inquiry. If the draftsman had known what taps were available he very likely could have varied other details so as to have used one of them. If the drafting room calls for a shaft 2 inches longer than the longest lathe in the shop will take, it may be possible to turn it by taking out two of the tail bolts and sliding the tailstock over the end of the bed; but if he could have found a way to get along without those 2 inches, the thing might have been turned with some degree of efficiency instead of having to nibble off the stock. If the draftsman had been given full particulars he could have avoided this difficulty, but if he had no information except what he could get by going into the shop on sufferance, he could not be blamed.

There is another thing that is the fault of the system, and that is the conflict of ideas as to what the designer should do and what belongs to the draftsman. A designer is apt to be a poor as well as an expensive detailer, because he hates to get into the puttering end of it. It is easy for him to sketch the larger and more important parts and then turn them over to the draftsman with instructions to fill in the details, but the filling in may be the most important thing of all. A good idea may be all that makes a machine possible, but it is attention to details that determines whether it can be made at a profit or not. There is need of some man intermediate between the designer and draftsman, who can decide manufacturing details. He would provide for oil holes and grooves, keys and set-screws, materials to be used, and the hundred and one little things that make it possible to utilize the idea of the man higher up. This position is one to which a draftsman or a machinist might aspire, but which neither could reach unless he was willing to learn to do the other man's work. My ideal would be a machinist who had learned to draw were it not for the limitations which his lack of early practice has put upon him. If the public schools could only be persuaded to give real courses in mechanical draw-

ing so that boys could use pencil and pen freely by the time they were sixteen years old, then they could serve an apprenticeship in a machine shop and in a short time make nearly ideal draftsmen, in line for promotion to any height to which their ability might lead them. Men of this type might not command high pay, but they would surely get steady work and a chance for promotion that would be worth more than immediate returns.

Take the man from the technical school. He is in the drafting room merely because he hopes to grow on the job; he has no intention of staying there a lifetime, and if he does it is because someone made a mistake. If his work is not satisfactory, there is an easy way to get it corrected in the future and that is to tell the college faculties what you want. They do not know the demands of the times and there is no way for them to find out unless you tell them. They are shut off away from the business world, busy about problems that are peculiar to their work and with neither the time nor the money to go about and find out at first hand what their graduates must know. When they come to see you, you are polite and do not talk shop too much, and they go away feeling that you are well pleased with their product, while what you should have done was to tell them wherein their young men are weak. They need to know it—it is their bread and butter—and I believe from my acquaintance among them that they would welcome every suggestion you might make, reserving only the right of counter-suggestion.

Another thing that should be possible in technical schools is the teaching of materials of construction in terms of material that is on the market. We may not want to advertise Novo or Blue Chip steel, but if we want to have it used we must say so. If we specify machinery steel we should know that what we want is a cheap grade of steel with little strength and wearing quality. Names of brands will change but it will not be any worse than teaching geography the next few years. I am also convinced that a stiff course in routing work for the shop, given to technical men before graduation, would be a great help to them as an "eye opener," as well as being of advantage to their future employers. A man who has sat down with pencil and paper to consider exactly what should be done first on a piece which he has detailed, exactly how the work is to be held at each stage of its progress, what kind of tools will be needed and how expensive a machine it will tie up, has inevitably begun to get an idea of the problems that lie before the man in the shop. He is also one step further from the idea that because a machinist takes pride in being able to do a difficult job, he ought to be supplied with a plenty of them to do.

To sum up this rather rambling paper, let me suggest: First, that the advent of large numbers of operators and changes in methods of manufacture during the past few years have made a totally new demand upon the drafting room. Second, that technical school graduates, who are apt to have considerable influence on drafting room methods are apt to be insufficiently trained in modern shop methods. Third, that professors of drawing have not been sufficiently informed of the new requirements in drafting rooms. Fourth, that the public schools should teach machine drawing in a thoroughly mechanical way to all boys who show any aptitude along mechanical lines, with emphasis on neatness and good lettering. Fifth, that a drawing should constitute an order and a record; and to that end, it should be followed implicitly in the shop or returned for correction; and requests for correction should be made in writing and in form to be filed away if accepted, so as to constitute a check on the draftsman's ability. Sixth, that the shop should keep the drafting room posted as to its possibilities and limitations in the way of tools and machinery, and its preferences for materials from a manufacturing point of view. Eighth, that very few boys should be encouraged to enter drafting as a trade unless they are willing to work for a considerable time in the machine shop, and some man with a thorough knowledge of shop work, preferably gained in a number of shops, should be placed in charge of detailing the ideas of the designer. Ninth, freer use of English notes supplemental to the information given by the drawing alone, should be encouraged.

## ESTABLISHMENT OF AMERICAN BANKING FACILITIES IN SOUTH AMERICA*

The industrial history of the United States may be studied with no little pride by our citizens. What has been accomplished during the comparatively brief life of the nation is truly remarkable and is evidence of what a determined people of intelligence, industry and ability are capable. The resources of our country are very great and even yet have been but lightly touched, our productive power is not impaired and thousands of acres still await the plough, so that we not only produce sufficient to provide food for our own large and growing population but are enabled to spare a very substantial amount for export to less fortunate countries. American inventive genius and skill have permitted our manufacturers to yearly increase their products until now we find it necessary to broaden our market. Our export statistics show that without very great effort, rather because of merit and demand, our manufactured articles go to foreign countries in increasing yearly volume. In years of dull local business, spasmodic efforts have been made to expand our exports of manufactures generally but a revival of home trade operations invariably brought with it a decline of interest in foreign trade. The truth is that only within the past few years has any real attention been paid to the possibilities of other markets for our wares than our own. Our exports in the main have been those the world sought rather than what have been sold by systematic effort. Such attention as has been paid to a foreign export trade has encountered so many obstructions and rough places that it was too often diverted. Prior to the Civil War, the United States did a considerable over seas trade but with that memorable struggle passed our merchant marine and the better part of our foreign trade. The minds of our business men turned to the needs of our country, the possibilities of an immense internal trade based upon our tremendous agricultural production were realized, and the remarkable growth of our railway system permitted rapid development. The opening of the country west of the Mississippi offered a great business field, and it is small wonder that we have, in watching the remarkable progress of our own country, but seldom permitted our business fancies to stray beyond our own borders. We have now reached that period in our industrial history when it behooves us to take cognizance of the foreign field. That we have been aware of this for some time is evidenced by the formation of various associations for the promotion of foreign trade, by the investigation of possibilities by some of our larger concerns and the increasing activity of our consular service and its effective work.

The results of such investigations made bring us face to face with the fact that a large foreign trade is not to be had for the asking, but is only to be realized by energetic methods and in the face of sharp competition. The field is a large one and the achievement of our purpose will only be realized after much patient work and a considerable revision of our methods. It is well said that it is "hard for an old dog to learn new tricks." Likewise it will prove hard for many ambitious manufacturers to dispose of their wares in foreign lands, to understand the necessity of consulting the particular needs of the countries they desire to enter, and the customs and ways prevailing there. But few of our merchants and manufacturers have had any considerable degree of experience in export and import trade; to the great majority it presents an entirely new field. It is obvious that a great deal of preliminary work must be done before we can be in position to reap the full rewards in the way of trade, which the excellence of our products entitles us to. Not the least of the lessons to be learned is to adapt ourselves to the customs and characteristics of the people whose trade we hope to enjoy. We Americans are just a little too much inclined to expect those we come in contact with to adapt themselves to our ways, rather than adapting ourselves to theirs. One of the complaints often made is that we will not pack our goods according to specifications given, frequently occasioning the rejection of the articles to the dissatisfaction of our shippers.

* Abstract of a paper read by H. R. Eldridge, vice-president of the National City Bank, New York City, before the convention of the National Machine Tool Builders' Association at the Hotel Astor, New York City, October 22-23, 1914.

It may be readily understood that if a shipment is made in ordinary packing cases of just sufficient strength to allow safe carriage in railway cars and of 100 or 200 pounds instead of medium sized cases strongly put up, the merchant receiving them on lighters, often on a rough sea, and required to transport them inland on the backs of animals, cannot be censured if he refuses the shipment rather than undergo the expense of repacking the articles. Errors of this nature are all too frequent and the criticisms offered are just. We must be careful to observe instructions and we should learn that orders must be filled exactly as given. Good service always means satisfied customers. We know that our chief competitors in the world's markets have been studying the situation for years, that they have built up a system giving them many advantages and that we cannot hope to make great progress until we ourselves have developed our facilities far beyond that which they now are. We cannot fail to realize what the lack of a merchant marine means, what great advantage their wonderful banking system gives to our competitors and the value of their years of experience. We must therefore not be disappointed if our progress in developing these markets for our products is slow, nor must we lose heart if the problem appears difficult of solution.

A great deal of attention has been paid recently to the possible development of good trade with the various countries of South America. Manifestly we are entitled to a considerable share of the trade of those countries. Our geographical location alone prompts that belief, and the further fact that we are a very large customer for their products. In looking over the possibilities in South America we must bear in mind that much preliminary work must be done, that we must study the situation carefully and build for time to come, rather than for the moment. The three greatest aids for the development of trade with South America; namely, a merchant marine, an effective banking system and the ability to finance large enterprises, have been at the disposal of our chief commercial rivals for many years and have been most advantageously used. It is not at all probable that we will have a merchant marine worthy of the name for several years to come, and then only when congress passes an act placing our ships on an equality with those of our competitors. The banking systems of the principal nations we must compete with are most important adjuncts and have done much to increase the trade they enjoy. Fortunately the new Federal Reserve Act has made some provision by which we can in a measure cope with the banking situation and this will be done in as intelligent a manner as the law permits. It is difficult, however, to see how we can well cope with the very decided advantage the financing of large projects gives to our commercial rivals. The United States has not yet reached that period in her history where she is financially independent and ready to take hold of large undertakings in other countries. We are yet young in the life of nations. Much of our prosperity, indeed the greater portion, is due to the liberal investments of foreigners in our securities, and it will be some little time before we can conveniently discharge those obligations if called upon. It is therefore apparent that our ambitions in the direction of expanding our trade in South America depend upon our genius and skill, the excellence of our products, and our tact and ability in handling business entrusted to us, rather than advantages due to our shipping and financing strength.

The sudden outbreak of hostilities in Europe some ten weeks since has had a profound effect upon the business interests of the world and for the time has made it impossible to foresee with any degree of certainty what the future holds in store. We do know that for a while at least, European nations involved will be but little inclined to invest liberally abroad and that obligations there maturing will be called for payment in many instances. When we consider that some of the European nations involved have been the principal financial backers of some, if not all, of the South American countries, we can better understand the keen interest in conditions those countries display and with what apprehension they look to the future. Conditions in South America generally have not been good for several years; in some countries they have really been acute, and with the complication produced by the war the situation has become most interesting and calls for much solicitude. That we could sell goods in South America in liberal quantities at this time is more than probable in view of the disrupted relations necessarily caused by the war, but that we would be justified in granting the European long terms of credit to which they are accustomed, is not so clear. The long terms of credit enjoyed by our Southern neighbors are directly the result of keen competition, and are likewise responsible in no little degree for the financial conditions there prevailing. All leniency should be shown in granting credit to responsible concerns, but when those terms go beyond the bounds of reason the road is paved toward the slough of speculation. If a merchant buys on six months time, an article which will be sold and realized upon within ninety days, he holds in his hands the proceeds ninety days longer than he should and the temptation is constantly before him to either buy more goods, often beyond his needs, or to employ the funds in some line of speculation, both leading to undue expansion and often to financial failure. It would be well, therefore, not to be too liberal in terms of credit, even though the development of trade be retarded thereby, yet not unreasonably chary of granting terms of a favorable nature when conditions justify.

The National City Bank of New York will open a branch at Buenos Aires, Argentine, and as soon as practicable another at Rio de Janeiro, Brazil. It is further intended to open other branches in other countries as occasion requires. The bank desires to do all it can to promote the increase of trade relations, and through its banking department offer a cheap and effective method of handling the exchanges between buyers and sellers. It is fully alive to the inconvenience probable exporters and importers suffer by the lack of dependable information of trade conditions, demands for certain lines of goods, shipping requirements, custom house regulations and dues, a knowledge of the products of the various countries which could be imported in the United States to advantage, their character, the avenues through which they could best be had, and the numerous other branches of information so requisite for the proper handling of the business obtainable. To permit of the dissemination of such information among American exporters and importers, it is the bank's intention to maintain a corps of trade experts at each branch, whose duty it will be to gather all the data possible that can be of benefit and to make it available in an intelligent manner through the columns of *The Americas*, which will be issued from time to time, and special bulletins when deemed advisable. Information of this character will no doubt be found quite valuable and may possibly prove the source of no little saving of expense to houses operating in South America. The service of this corps will be available to American merchants and special reports can be arranged for when desired. The bank will establish a credit department in each branch and hopes within a reasonable space of time to be able to furnish exporters and importers valuable information as to the standing of South American dealers. It may be readily understood that it will take some little time to perfect such an undertaking, but when once the work is done, the service should prove of great value. The National City Bank earnestly desires to cooperate with the business interests of the country and sincerely hopes its efforts in this direction will do much to stimulate and increase the present trade relations we now enjoy with our neighbors to the South. The bank is not unmindful that it is entering a field with which few American financial institutions are familiar, that it will encounter many obstacles and perhaps often suffer inconveniences both to itself and its customers, and that it has much to learn from experience. It embarks upon the enterprise filled with a sincere desire to serve American trade as advantageously as possible. Its great hope is to do all it can to remove the many disadvantages our trade has suffered from the lack of American banks in foreign countries and to give the "dollar draft" its well deserved standing in the markets of the world.

In conclusion it may not be amiss to say that the effect of the Federal Reserve Act will be to considerably improve our ability to handle foreign trade. Not only does it serve to mobilize and make more effective credit extension power, but

it puts a premium upon paper arising from actual commercial transactions and serves as at least a beginning toward the establishment in this country of a long needed discount market. The Federal Reserve Act marks the greatest step forward we have ever made in the perfection of our financial system, and though it lacks much of completing the task, it will surely make many needed amendments so pronounced that before many years have passed it will be so revised as to give to our country the advantageous position in the money marts of the world to which our large gold stock, our resources, our abilities, our wealth and our great commerce entitle us.

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## AN IMPROVED PROTRACTOR SCALE

BY ARTHUR E. BLOFIELD*

In order to make a protractor scale which can be accurately set and read, and at the same time to avoid the necessity of making the dial very large, I have recently invented and patented a method of graduation shown in Fig. 1. It will be seen that the scale is graduated from zero to 90, both ways from the center, by intervals of 10 degrees; and that there are ten circles on the dial concentric with the outer circle on which the graduation marks are numbered. Each of the inner circles has a degree mark graduated on it for each interval of 10 degrees on the outer circle, these degree marks running from the center to the outer circle and forming the intermediate graduations between zero and 10, 10 and 20, etc. The concentric circles on the dial on which the degree graduations are marked, are continued across the indicator and numbered from 1 to 9, thus making it an easy matter to read the odd degrees. Graduated in this way, it is possible to have a dial on which the graduations are sufficiently separated to make it possible to set and read the instrument accurately; and at the same time, the dial need not be more than 1½ inch in diameter.

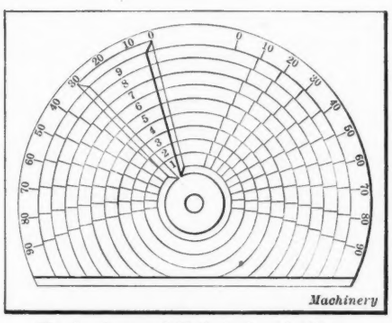


Fig. 1. Improved Method of graduating a Small Protractor Scale

Fig. 2 shows a combination tool which I have made, that is equipped with one of these patented dials. This tool can be used as a protractor, a square, a depth gage or a caliper. The method of using the tool as a protractor will be evident

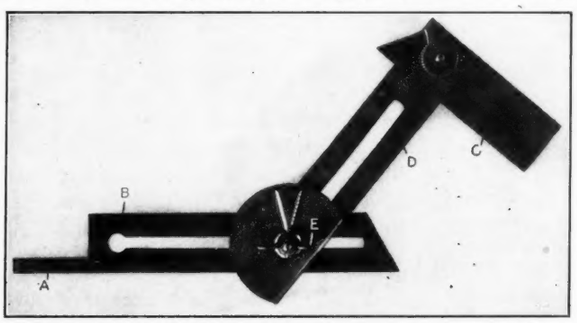


Fig. 2. Combination Tool provided with Improved Protractor Scale

from the illustration. In this connection, it may be mentioned that for certain classes of work where long legs are required, the scale *A* may be drawn out to expose its full length beyond the end of the blade *B*. Likewise, the extension *C* would be set parallel with the stock *D*. The tool would then be adjusted to bring the edges into contact with the surfaces forming the angle to be measured. To use the instrument as a square, the blade *B* and stock *D* are set at right angles to each other by means of the protractor scale, and for measuring large work advantage may be taken of the extra length provided by the use of the scale *A* and the extension *C*, as mentioned in describing the use of the tool as a protractor. When used as a caliper, the blade *B* and stock *D* are set at right angles to each other—as in the case where the tool is used as a square—and the extension *C* is also set at right angles to the stock *D*. The wing nut *E* is then loosened to allow the blade *B* to be brought into contact with the work, after which the dimension is secured from the scale on the stock *D*. For use as a depth gage, the blade *B* is set around at right angles to the stock *D*, the wing nut being left loose and the end of the blade *B* pushed down to the bottom of the hole. The wing nut is then tightened and the depth of the hole read on the scale. In using a combination tool of this kind, many mechanics would doubtless find other uses to which it could be put.

* Address: 204 E. 124th St., New York City.

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## WHEELS FOR CYLINDRICAL GRINDING

We call your attention to the following statement in the article "Selection of Wheels for Cylindrical Grinding," by F. B. Jacobs, in the October number of MACHINERY. "The best and purest corundum is found in Canada. * * * It cannot be denied that pure corundum makes a fast cutting wheel for most purposes, but *owing chiefly to the prohibitive cost of the raw material, corundum wheels are not commonly sold in competition with wheels made of artificial abrasives.*" The italics are ours.

We object to this statement, as being inaccurate and malicious. Mr. Jacobs is too well acquainted with the grinding wheel industry not to know the facts. Wheels made of Canada corundum (formerly called Craig Mine) are in use throughout the entire world. Corundum wheels have proved their superiority, not only for a few purposes as inferred by Mr. Jacobs, but for a vast number of grinding operations. Corundum wheels are being made in large quantities now, not only by us but by a dozen other American wheel manufacturers and they will continue to be made. The supply of Canada corundum is practically unlimited.

Our output of Canada corundum wheels amounts to hundreds of thousands of dollars worth annually, and these wheels are sold in competition with wheels made of artificial abrasive. We hold no prejudice against artificial abrasives, but on the contrary we ourselves make wheels of artificial abrasives, using both bauxite and silicide of carbon, as we have found that both artificial and natural abrasives have their advantages on certain kinds of work.

We wish to correct the impression given by Mr. Jacobs that corundum wheels are *passé*, that they are higher priced than artificial abrasives, or that corundum wheels are not and cannot be sold in competition with wheels made of artificial abrasives. Being the largest user of Canada corundum in this country, and actually interested largely in the Manufacturers Corundum Co. which operates all of the Canadian Corundum mines, we know whereof we speak.

Providence, R. I. AMERICAN EMERY WHEEL WORKS
* * * J. O. Smith, V. P.

## PERSONALS

Otto Abrahamsen, treasurer of Beaudry & Co., Inc., Boston, Mass., has returned from a five months' trip through Europe.

William J. Sansom, formerly tool supervisor with the Hart-Parr Co. of Charles City, Iowa, and later in the employ of the state of Wisconsin at Madison, Wis., is now instructor in mechanical practice at the University of Wisconsin.

Carl H. Clement, until lately chief engineer and sales manager of the Metal Products Co., Detroit, Mich., has resigned and gone on the road as sales engineer for the Bock Bearing Co., Toledo, Ohio, manufacturer of roller bearings.

Ellis F. Muther, formerly Eastern sales manager of the Gisholt Machine Co., Madison, Wis., with headquarters at New York City, has been appointed general sales manager in charge of general sales and advertising work, with headquarters at the Madison office.

Prof. Frederick R. Hutton, honorary secretary of the American Society of Mechanical Engineers, addressed a joint meeting of the Engineers Club of Cincinnati and the Cincinnati Section of the A. S. M. E., October 15, on the subject: "The Testing of Motor Vehicle Engines."

J. E. Brandt, for a number of years manager of the Philadelphia office of the Gisholt Machine Co., has become associated with the Swind Machinery Co., Philadelphia, in the capacity of vice-president. The Swind Machinery Co. has been appointed selling agent for the Gisholt Machine Co. in the Philadelphia district.

WHEN you have stopped to figure out what was really responsible for continuous useful service in milling machines, have you ever thought of how big a part good bearings play? Because this point is not immediately noticeable less attention than it deserves is paid to it. Think this over when you buy your next milling machine.

# Scraping for a Good Bearing—Not for Finish

**Our New Book**

"Practical Treatise on Milling and Milling Machines" is ready. It gives you the information you need to operate modern milling machines successfully.

Useful to operators, shop foremen, superintendents, technical school instructors and students. 332 pages —210 illustrations.

Flexible cardboard covers . . . . $1.00
Stiff cloth covers 1.50

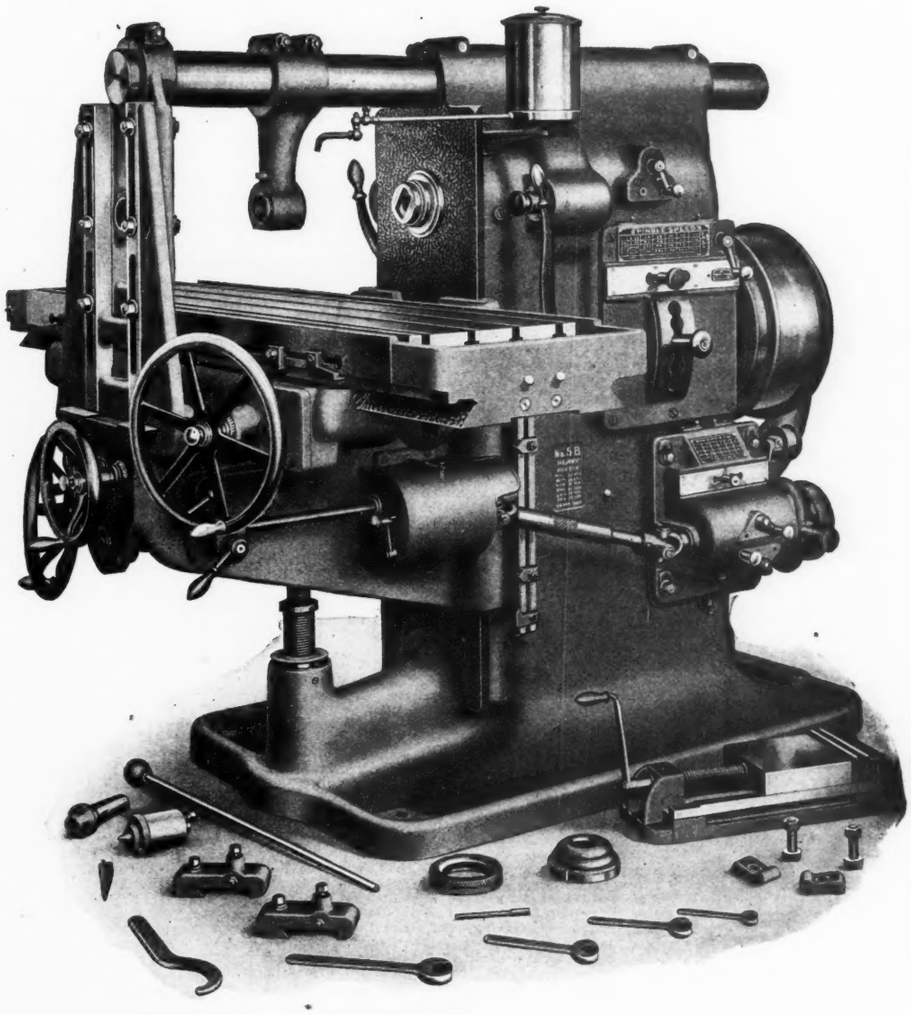
Quality in bearings is difficult to detect at once. Time is the final test of worth. Bearings may look alike, but constant service soon shows up any inferior work to the detriment of both the machine and its product.

Our methods of getting correct and properly aligned bearings are such as to insure the best of results. To begin with, the iron that goes into our castings is hard and close grained, giving superior wearing qualities. Bearings are liberally proportioned and solidly supported. These features are highly important if alignments, once made, are to be permanent. Again in scraping, our expert scraper hands carefully secure full, flat, correctly aligned bearings in every case, thus insuring a high degree of accuracy and efficiency.

Cylindrical bearings too are finished just as carefully, and they are proportioned and arranged so that as efficient and durable a drive as possible is secured throughout the machine.

That is why B. & S. Machines remain accurate through years of constant service, because the bearings—the life of the machine—are large, solidly supported, and true.

# Brown & Sharpe Mfg. Co.,



# A Powerful Heavy Service Milling Machine

that is rugged enough for the heaviest kind of milling is something that can be used to good advantage in any shop doing heavy work. Railroad shops, engine builders, and machinery plants handling similar lines of work will find our line of heavy service milling machines unusually complete and well adapted to their various needs.

Our No. 5-B Heavy Plain Machine shown above is a good example of this line. The massive proportions, large bearings, powerful drive, and the general ease with which a machine of this size can be handled make it indispensable in a shop interested in economical production of heavy work. There are features such as our efficient speed and feed changing mechanisms, automatic fast feed, locking device for back gears, fine adjustment for the spindle, and many others which mean better work with less effort for the operator. Can you use such a machine? Think it over and write for descriptive literature.

**No. 5 B Heavy Plain Milling Machine**

Capacity: longitudinal feed, 50"; transverse feed, 12"; vertical feed, 21". Either automatic or hand. Size of table, 81" x 21". Working surface, 68" x 21".

# Providence, R. I., U. S. A.

READ PAGE 79

George W. Kerr, for a number of years automobile body engineer of the Stevens-Duryea Co., Chicopee Falls, Mass., has resigned. Upon leaving, Mr. Kerr's associates and employes gave evidence of the high esteem in which he was held by presenting him with a beautiful jeweled Knights Templar charm, together with their best wishes for future success.

Frederick W. Gates has resigned the position of publicity engineer with the Greenfield Tap & Die Corporation, Greenfield, Mass., the resignation taking effect November 1. Mr. Gates will open an office at 30 Church St., New York City, for a sales and advertising service limited in its scope to mechanical subjects. His familiarity with mechanical details and knowledge of technical data fit him for giving service to clients in the mechanical field.

Samuel Insull, president of the Chicago Commonwealth Edison Co., Chicago, Ill., recently donated $6000 to the Franklin Institute of Philadelphia for the maintenance of a Franklin gold medal which was thereby founded. The Franklin medal is to be awarded from time to time in recognition of distinguished achievements in science and technology. The medal was designed by Dr. R. Tait McKenzie of the University of Pennsylvania; it bears on the obverse a medallion of Benjamin Franklin taken from his portrait by Sully.

* * *

## OBITUARIES

Erwin Riecke, brother of Herman Riecke of Ernst Krause, Vienna, was killed in battle near Verdun, France. He was well known among the machine tool trade in the United States, having been employed by Lodge & Shipley Machine Tool Co., Cincinnati-Bickford Machine Tool Co., Cincinnati Milling Machine Co., and other Cincinnati concerns. He had recently arranged to handle the Lodge & Shipley line in some parts of Europe in connection with the company's agents there.

Edwin Hawkridge, president of the Hawkridge Bros. Co., Boston, Mass., died October 21 of Bright's disease, aged sixty years. He was born at Valley Stream, Long Island, N. Y., and first entered the steel business with Hogan & Burroughs, New York City in 1877. He went to Boston in 1881 as manager of the steel department of Fuller, Gaynor & Fitz. With his brother, John F. Hawkridge, he started the firm of Hawkridge Bros. in 1883, which was incorporated in 1909 under the name of Hawkridge Bros. Co.

Charles S. Stallman, president of the Pacific Coast Tool & Supply Co., San Francisco, Cal., died September 24 after an illness of but five days of pneumonia. Mr. Stallman was well known in the machinery trade, and his many friends both East and West will regret to hear of his untimely death. He possessed the qualities that win friends and make for success. His business was practically wiped out by the fire and earthquake in San Francisco, but on the ruins he and his associates had again built up a successful business.

Spencer Van Cleve, treasurer of the Erie Foundry Co., Erie, Pa., died September 29, following an illness of eight weeks with pneumonia, aged forty-five years. Mr. Van Cleve was a graduate of Princeton University, and became interested in the Erie Foundry Co. when it was a small concern with a capital of only $10,000. He was made president of the company at that time, and was successful in building up the business. At the time of his death he was also vice-president of the Duntley Products Co. and the Fulton Mfg. Co.

## COMING EVENTS

**December 1-4.** Annual meeting of the American Society of Mechanical Engineers, New York City; Engineering Societies Bldg., 29 W. 39th St., headquarters. Calvin W. Rice, secretary.

**December 9-12.**—Eighth annual convention of the National Society for the Promotion of Industrial Education, Richmond, Va. C. A. Prosser, secretary, 140 W. 42nd St., New York City.

**December 12-19.**—Second International Exposition of Safety and Sanitation, Grand Central Palace, New York City. F. W. Payne, manager, Department of Exhibits, 29 W. 39th St., New York City. The exhibit offers the opportunity to manufacturers of safety and sanitation devices to bring their products to the attention of large numbers advantageously. Last year 110,000 attended the exposition and the attendance expected this year is about 125,000.

## SOCIETIES, SCHOOLS AND COLLEGES

**American Society of Mechanical Engineers,** 29 W. 39th St., New York City. Condensed catalogue of mechanical equipment. 307 pages, 6 by 9 inches.

**The Franklin Institute of the State of Pennsylvania,** Philadelphia, Pa. Year Book for 1914, 104 pages, 6 by 9 inches, containing a list of officers, committees and membership of the institute, and a historical note relating to the work that has been done, as well as the 1914-1915 lecture program.

## NEW BOOKS AND PAMPHLETS

**Safety in Moving-Picture Theaters.** 40 pages, 4 by 6 inches. Published by the Travelers Insurance Co., Hartford, Conn.

**Practical Handbook for Beet-sugar Chemists.** By Werner Moeller-Krause. 140 pages, 19 illustrations. Published by the Chemical Publishing Co., Easton, Pa. Price, $1.25.

**United States Coals Available for Export Trade.** By Van H. Manning. 15 pages, 6 by 9 inches. Published by the Bureau of Mines, Department of the Interior, Washington, D. C., as Bulletin 76.

**Hints on Coal-mine Ventilation.** By J. J. Rutledge. 22 pages, 6 by 9 inches. Published by the Bureau of Mines, Department of the Interior, Washington, D. C., as Miners' Circular 16.

**Thermal Properties of Steam.** By G. A. Goodenough. 69 pages, 6 by 9 inches. 16 diagrams. Published by the Engineering Experiment Station, University of Illinois, Urbana, Ill., as Bulletin 75. Price, 35 cents.

**A Study of the Oxidation of Coal.** By Horace C. Porter and O. C. Ralston. 30 pages, 6 by 9 inches. 12 illustrations. Published by the Bureau of Mines, Department of the Interior, Washington, D. C., as Technical Paper 65.

**The Explosibility of Grain Dusts.** By David J. Price and Harold H. Brown. 59 pages, 6 by 9 inches. Illustrated. Published by Millers' Committee of Buffalo, N. Y. George F. Urban, secretary, George Urban Milling Co., Buffalo, N. Y.

**Illuminating Power of Kerosenes.** By William Kunerth. 31 pages, 5¾ by 8¾ inches. Illustrated. Published by the Engineering Experiment Station of the Iowa State College of Agriculture and Mechanic Arts, Ames, Iowa, as Bulletin 37.

**Statistics of Railways of the United States, 1900-1912.** 76 pages, 6 by 9 inches. Published by the Bureau of Railway Economics, Washington, D. C., as Bulletin 66.

This valuable compendium of statistics pertains to population and area; railway mileage; capital, securities and dividends; revenues, expenses and taxes; employes and compensation; equipment; freight traffic statistics; and passenger traffic statistics. The data is segregated by areas, classes of employes, locomotives, cars, etc., and hence is a mine of information on subjects difficult to find in ordinary statistical records.

**Die-making Practice.** 46 pages, 6 by 9 inches. 36 illustrations. Published by the Industrial Press, New York City. Price, 25 cents.

There are too few good books on die-making and punch and die work. This book, which is No. 131 of MACHINERY's Reference Books, will, therefore, be welcomed by those interested in this subject. It contains a great deal of practical information on die-making, and descriptions of tools used in multiple-plunger presses. Sub-press die construction is also dealt with, and the making of one-piece armature disk tools is described in detail. The book is especially adapted for toolmakers and tool-designers and will appeal to those responsible for production by means of punches and dies.

**Pattern Making.** By Frederick W. Turner and Daniel G. Town. 114 pages, 4¾ by 7 inches. 88 illustrations. Published by John Wiley & Sons, Inc., New York City. Price, $1 net.

This little book is not intended primarily for the general patternmaker, but rather for the younger members of the craft and other learners of the trade. It deals with general trade relations and qualifications of the patternmaker; foundry and machine shop practice; allowances and their effect on patterns; bench machine and special tools; lay-outs and templets; materials of construction, fastening and finishing of patterns; types of patterns; core prints; construction of patterns; core-boxes and cores; skeleton patterns and sweeps; and specialization in the pattern shop and foundry.

**Gaging Tools and Methods.** By Franklin D. Jones. 48 pages, 6 by 9 inches. 39 illustrations. Published by the Industrial Press, New York City. Price, 25 cents.

This is MACHINERY's Reference Book No. 130. It deals with the various forms and types of gages and measuring instruments used in machine shops and tool-rooms. In the four chapters, the author takes up classes of standard measurements, calipers and micrometers, fixed and adjustable gages, miscellaneous gaging tools, and measuring machines. The book covers quite completely the measuring instruments ordinarily found in machine shops, and is one which every mechanic, whether at the bench, at the machine, or at the drafting-board, should add to his library of trade literature.

**Sheet Metal Working.** By F. Georgi and A. Schubert. 160 pages 5½ by 8¾ inches. 125 illustrations and two folding plates. Published by Scott, Greenwood & Son, London; and D. Van Nostrand & Co., New York City. Price, $2.

This book on sheet metal working, translated from the German, is intended for the instruction of beginners. It comprises cutting, punching, bending, folding, pressing, drawing and embossing metals and machinery for same. The first chapter gives a brief history of the iron and sheet metal working industry, and then the properties of metals are taken up, following which is a chapter on devices and machines for bending bar iron, etc. Treadle presses, foot presses and tools for same are described, following which are chapters on curling and flattening sheet metal, raising and hollowing, slot punching machine, machines for making cutting tools, press tools for making water pails, burr trimming device, clamps, rolling, tool materials, etc.

**Patents.** 48 pages, 6 by 9 inches. Published by the Industrial Press, New York City. Price, 25 cents.

This book, which is No. 134 in MACHINERY's series of 25-cent Reference Books, deals with the principal provisions of the patent law, the procedure in obtaining patents, and covers in detail actual and constructive patent infringements. Many of the provisions of the patent law, in their legal form, are rather obscure to the average reader. In this book these provisions have been explained in a popular manner, and numerous examples of the workings of the patent laws have been given. Every mechanic will, at some time in his career, meet with conditions where knowledge of the patent law is necessary. He will either want to apply for a patent himself, or to acquire a patent owned by somebody else; or he may be in doubt as to whether or not he is infringing somebody else's patent. This book will prove of considerable value under all of these conditions.

**Examination of Lubricating Metals.** By Thomas B. Stillman. 129 pages, 6 by 9 inches. 116 illustrations. Published by the Chemical Publishing Co., Easton, Pa. Price, $1.25.

The efficiency and durability of machines are to a large degree affected by the kind of lubricating oil used on their bearings. The importance of efficient means of testing lubricating oils can, therefore, hardly be exaggerated. This work, which is based on many years of experience of the author, deals with specific gravity, cold test, viscosity, iodine absorption, flash and fire tests, acidity, Maumene's test, color reactions of oils with nitric and sulphuric acids, separation of mineral from a vegetable or animal oil, gumming and sulphur tests, tests for water, test for gasoline, carbon residue test, microscopical examination, fixed carbon in oil, estimation of paraffin in mineral oils, soap test, greases, coefficient of friction, value of graphite as a lubricant, fuel oil specifications, etc. An unusual feature of the work is quotations of wholesale prices of various substances, many of which are used in lubricants.

**Practical Iron Founding.** By J. G. Horner. 409 pages, 5 by 7 inches. 283 illustrations. Published by D. Van Nostrand Co., New York City, and Whitaker & Co., London. Price, $2.

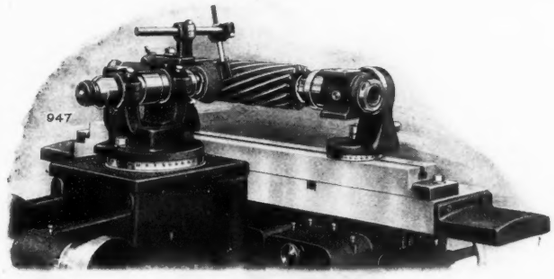
This is the fourth edition of a work on the principles and practice of iron founding, written both for the student and the practical man. During recent years, great changes have taken place in iron founding and the fourth edition has been doubled in size in order to deal adequately with the improvements such as machine molding, etc., that have been developed. The contents deal with principles; molding sands and their preparation; melting and testing of iron; cupolas, blasts and ladles; the equipment of foundries; molding boxes and tools; shrinkage, curving, fractures and faults; principles of green sand molding; examples of green sand molding; dry sand molding; cores; loam work; elements of machine molding; molding machines; machine molded gears; sand mixtures, etc. The work is of a strictly practical character, containing many illustrations and being one that can be recommended to all in need of a work of its nature.

# GRIND RIGHT

**Milling Cutters must be ground with the correct clearance to give maximum production**

## The Cincinnati No. 2 Universal Cutter and Tool Grinder

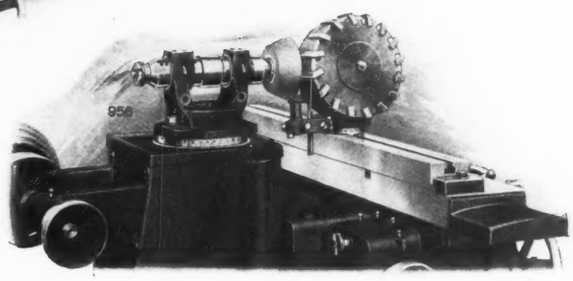
**rapidly and correctly sharpens all styles and sizes of milling cutters within its range**



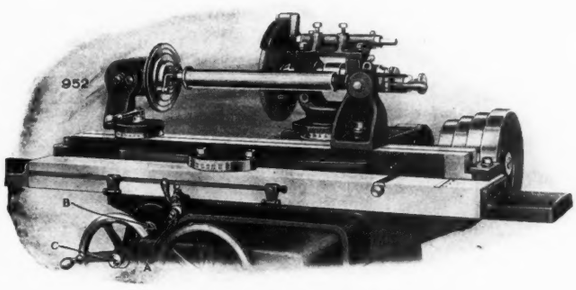

Spiral Mill

Clearance angle for all cylindrical cutters is read directly from the swivel head.

End mills, face mills, etc., held for sharpening operations just as they are held in the milling machine spindle.



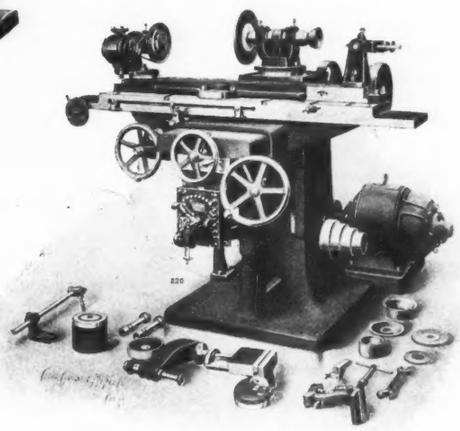

12" Face Mill




Circular Grinding Attachment
Automatic Feed

Equipped with cylindrical, internal and surface grinding attachments, it grinds all work in the tool-room.

**Motor driven entirely self-contained. Countershaft driven requires only one belt from line shaft.**




No. 2 Grinder Motor Driven

**New catalogue gives complete details**

## THE CINCINNATI MILLING MACHINE COMPANY

CINCINNATI, OHIO, U. S. A.

**Boring, Recessing and Multiple-turning Tools.** By Albert A. Dowd. 48 pages, 6 by 9 inches. 33 illustrations. Published by the Industrial Press, New York City. Price, 25 cents.

Whether the planning of the tool equipment in a shop is done by a designer employed exclusively on this work or by the foremen and machinists, the directions for the design, construction and application of the boring, recessing, adjustable and multiple-turning tools illustrated and described in this book, which is No. 128 of MACHINERY'S Reference Books, will be found of great value. The book is made up of articles on this subject published by the author in MACHINERY during the past year. These articles describe fundamental principles and constitute the most nearly complete descriptions of tools and devices for turning and boring operations ever published. The devices shown and described are examples of design actually employed in practice and successfully applied to productive work in a great number of manufacturing establishments. The book contains complete drawings and descriptions of thirty-three different tooling arrangements and tool-holding devices actually used in practice to increase production and facilitate the turning out of accurate work.

**Hendricks' Commercial Register of the United States.** 1600 pages, 7¼ by 10 inches. Published by the S. E. Hendricks Co., Inc., New York City. Price, $10, carriage prepaid.

The twenty-third annual edition of Hendricks' Commercial Register of the United States for buyers and sellers, is the most complete edition of this work that has been published. Many new features have been added to enhance its value, and thousands of trade names and titles of identification have been inserted, and numerous duplications expunged. The "Assistant Buyer," formerly published by the Sullivan System, has been incorporated with the Commercial Register, and the entire work has been revised and improved in details. It contains about 350,000 names and addresses, and upward of 45,000 business classifications. An indication of the extent of the work is the fact that 138 pages are required to index its contents. The work needs no introduction to buyers, having been in existence nearly a quarter of a century. It is used extensively throughout the United States and many foreign countries by corporations, associations, manufacturers, exporters, purchasing agents and sales managers, and can be heartily recommended to all having use for a work of this sort.

**Modern Blanking and Piercing Dies.** 48 pages, 6 by 9 inches. 41 illustrations. Published by the Industrial Press, New York City. Price, 25 cents.

Punches and dies are made in such a variety of designs and for so many different purposes that it is difficult to treat the subject of die construction and design in a general way and present fundamental principles that can be applied universally in the art of die-making. For that reason, die-makers in describing their methods have almost invariably confined themselves to specific die designs instead of attempting to deal with uncertain theories. These examples, by being properly classified, can be made of great practical value because they show what has been accomplished and suggest methods for other classes of work. The book under review, which is MACHINERY'S Reference Book No. 132, describes a great number of designs of blanking and piercing dies laid out according to the most modern approved methods. Special attention has been given to sectional punch and die construction. The tools described are illustrated by numerous engravings showing the exact method of design and construction. The subject is handled in a way that will meet the requirements of toolmakers, tool-designers, and others responsible for the successful application of punches and dies.

**Experiments.** By Philip E. Edelman. 256 pages, 5¼ by 7¾ inches. Illustrated. Published by Philip E. Edelman, Minneapolis, Minn. Price, bound in cloth, $1.50; bound in leather, $3.

The work is divided into two parts, the first part being devoted to selected experiments, easily carried out, which include demonstrations in science, physics, chemistry, electricity, wireless communication and mechanics. The second part is devoted to the principles of original experimenting in science, invention and the industries. Chapters are included on industrial testing and commercial experiments. The general contents comprise: Models, Copies and Makeshifts; Simple Experiments in Chemistry; Miscellaneous Applications of Chemistry; Simple Catalytic Experiments; Deposition of Metals and Electroplating; Electrochemistry; Small Electric Motors; Electric Heating Devices; Electric Arc; Electromagnetic Experiments; Electric Transformers, Induction Coils and Their Applications; Wireless Telegraphy, Telephony and Control Apparatus; Telegraphy and Picture Telegraphy; High Frequency Currents; Phosphorescence and Ultra-violet Rays; Graphite Particles; Radiography and X-rays; Static Electricity; Horticulture; Aeronautics; Microscopy and Microscopic Photography; Science and Invention; Essential Processes in Experimenting; Fundamental Experimental Principles; How to Conduct an Original Research; Testing, etc.

**Hobs and Gear Hobbing.** By John Edgar. 48 pages, 6 by 9 inches. 47 illustrations. Published by the Industrial Press, New York City. Price, 25 cents.

The hobbing process for cutting the teeth in spur and spiral gears is now widely used. It is a comparatively new process and one on which, for this reason, there is little or nothing published in book form. Seeing the need for a practical treatise on the subject, MACHINERY has, therefore, compiled material for one of its Reference Books, giving all the available and essential information of interest to mechanics. The principles of the hobbing process are first dealt with, after which the design of hobs for spur and spiral gears is taken up, the shape of hob teeth, their relief, the number of flutes, and other questions pertaining to the making of hobs being dealt with. Special attention is given to the defects in hobs and the means by which these can be partially or wholly avoided. One chapter deals with special hob tooth shapes, including application of the hobbing process to the cutting of ratchets, spline shafts, square shafts, etc. Still another chapter deals with the important subject of centering the hob in gear hobbing, showing how the effect of defective hobs may be eliminated by the careful application of a few simple rules. A comparison between the hobbing and milling of gears is also given. The book should be of interest to all mechanics having to do with gear cutting or gear hobbing.

**Heat-treatment of Steel.** 278 pages, 6 by 9 inches. 73 illustrations. Published by the Industrial Press, New York City. Price, $2.50.

In the development that has taken place in the methods and processes pertaining to the machine-building trades during the past fifteen years, most remarkable changes have been wrought in the heat-treatment of steel, including the hardening, tempering, annealing and casehardening of the various kinds. This book places on record the modern methods now employed in the heat-treatment of steel and includes also a treatise on the methods used for measuring the hardness of metals by the various hardness testing apparatus that have been developed in this country and abroad. Special attention has been given to a number of methods recently developed, making this book a most modern and complete treatment of the subject; as an example of the new methods dealt with may be mentioned the comprehensive treatment given to electric hardening furnaces and to casehardening by carbonaceous gas. The best idea of the contents of the book may be obtained from the various chapter heads which are as follows: Hardening Carbon Steel; Heating the Steel for Hardening; Quenching and Tempering; Heat-treatment of High-speed Steel; Heat-treatment of Alloy Steel; Heat-treatment of Steel by the Electric Furnace; Metallic Salt Bath and Miscellaneous Types of Electric Furnaces; Miscellaneous Hardening Methods, including Packhardening, Local Hardening, Heat-treatment of Steel Castings, etc.; Casehardening; New Casehardening Methods; Heat-treatment of Gears for Machine Tools; and Testing the Hardness of Metals. As a reference book, giving specific and detailed directions for the heat-treatment of steel, the book can be thoroughly recommended.

**Spiral and Worm Gearing.** 274 pages, 6 by 9 inches. 132 illustrations. Published by the Industrial Press, New York City. Price, $2.50.

The subject of spiral and worm gearing has often been presented in so theoretical a manner that many have assumed it to be very difficult to master. It is possible, however, to present the principles of the design and calculation of spiral and worm gearing in such a way that they can be readily understood, without resorting to a highly theoretical treatment; and in preparing this book, the first consideration has been to treat the subject in such a way as to meet the practical requirements of the machine building trade. As a result, mere theory and academic discussions have been avoided; the rules, formulas and instructions are illustrated with engravings whenever necessary, and numerous examples are given to show their application to problems met with in machine design. The scope of the book can be most easily understood by giving the headings of the twelve chapters of which the book consists: Principal Rules and Formulas for Designing Spiral Gears—Formulas for Special Cases of Spiral Gear Design—Herringbone Gears—Methods for Forming the Teeth of Spiral and Herringbone Gears—Hobs for Spur and Spiral Gears—Calculating the Dimensions of Worm Gearing—Allowable Load and Efficiency of Worm Gearing—Design of Self-locking Worm-gears—Hindley Worm and Gear —Methods for Forming the Teeth of Wormwheels—Gashing and Hobbing a Worm-wheel—Hobs for Worm-gears. The book is one which can be thoroughly recommended to anybody interested in spiral and worm gearing, as it places on record a great deal of information that has not previously been available in book form and which has been selected and used in this book because of its practical value.

**Turning and Boring.** By Franklin D. Jones. 307 pages, 6 by 9 inches. 216 illustrations. Published by the Industrial Press, New York City. Price, $2.50.

In his preface to this book, the author states that the specialization of machine tool manufacture has been developed to such a degree that there is need also for treatises which specialize on different classes of tools and their application in modern practice. This book has, therefore, been prepared to deal exclusively with the use of various types of turning and boring machines and their attachments. On this subject it is unusually complete, and, in addition to standard practice, describes many special operations seldom or never dealt with in books on machine shop practice. A unique feature of the book is that very little space has been given to mere descriptions of different types of machine tools, the principal purpose having been to explain the use of the machines and to solve the problems that are met with in their operation, rather than to dwell on constructional details. In selecting the examples by means of which the methods of operation are illustrated, care has been taken to select those important and useful operations that would best exemplify general principles. In preparing this book, the author, who is well known as the author of MACHINERY'S 25-cent Reference Books on machine tool operation, has made use of much of the material published in Reference Books Nos. 91, 92 and 95, which appears here together with a great amount of additional information on modern boring and turning methods. The book contains sections on the following subjects: The engine lathe; turning tools and cutting speeds; taper turning; special turning operations; thread cutting in the lathe; turret lathe practice; vertical boring mill practice; horizontal boring machines and their use.

**Science and Practice of Management.** By A. Hamilton Church. 535 pages, 5 by 7¼ inches. Published by the Engineering Magazine Co., New York City. Price, $2.

The literature on shop management is becoming quite extensive and a large variety of principles, theories and views on the efficient conduct of industrial enterprises have been set forth. The latest work, by Mr. Church, is well worth the attention of general managers, superintendents and students of practical economics. It is based on the proposition that manufacturing activity can be analyzed into certain well defined factors and that the principles of the art of management can be reduced to one of three main groups, viz: (1) The systematic accumulation and use of experience; (2) the economic control (or regulation) of effort; (3) the promotion of personal effectiveness. The work is divided into two parts, the first part dealing with the science of management and the second with the practical organization of the organic functions. In the first part, the author discusses the two great instruments of management, the organic functions of manufacturing organization, the regulative principles or "laws of effort," and their practical application to the relations of the manager to the instruments of management. In the second part, he deals with organizing the functions of design, equipment, operation and comparison, and the installation of the function of control. The principles and the relations set forth are to some extent illustrated and made clear by means of colored diagrams or charts printed on inserts. The work is not one to be recommended to the individual who would extract from it a ready-made system of management to apply to his particular case, but it contains much food for thought for him who would understand principles and apply them in the intelligent control of his business.

**Foremen and Accident Prevention.** 80 pages, 4 by 6 inches. Published by the Travelers Insurance Co., Hartford, Conn.

The booklet is based upon the extensive experience of the Travelers Insurance Co. in accident prevention work and will be found of practical help in manufacturing plants generally in securing cooperation of the foremen. The relation of the foreman to the employe is discussed, following which the body of the work is arranged alphabetically, thus making reference to any desired information easy. The contents are indicated by the following heads. Acids; air, alcohol; artificial respiration; belting; belts; blasting; blood poisoning; boards; boilers and other steam apparatus; breathing; building; caisson work; carelessness; caustic; chains; chemicals; chipping; cleanliness; clothing and hair; compressed air; construction work; conveyors; cranes; cuts; dashpots; demolition; devices, safety; digging; doctors; doors; dust; dynamite; electrical apparatus; elevators; emery wheels; engine rooms; excavations; explosives; eyes; fans; fire precautions; first aid; floors and passageways; foot-boards; foreigners; fumes; gas; gasoline; gears; glass; goggles; governors; grinding wheels; grindstones; guards; hair; hoisting machinery; hooks; ice; idling; injuries; inspections; instruction; interpreters; intoxication; jacks; japan; lacquer; ladders; law and ordinances; light; machines and machinery; materials, storage of; metal scrap; nails; neatness; oiling; painting; panics; passageways; physicians; platforms; poisons; pulleys; railings and foot-boards; railroad dangers; respiration, artificial; respirators; roofs; rope; rubbish; rules; runways; safety belts; safety devices; safety stops; sanitary conditions; scaffolds and stagings; scrap; set-screws; shafting; shoes; sickness; signs; slings; slivers; spitting; stairs and stairways; stops; safety; storage; suggestions from employes; switch-boards; teaming and trucking; toe-boards; tools; trenches; unemployed persons; vapors; ventilation; visitors; windows; wire rope; wires; wood alcohol; wounds; wrecking; yard conditions.

**Gas, Gasoline and Oil Engines.** By Gardner D. Hiscox. Revised by Victor W. Page. 640 pages, 6 by 9 inches. 435 illustrations. Published by Norman W. Henley & Son, New York City. Price, $2.50.

The interest in the internal combustion engine is indicated by the fact that this revised work is the twenty-first edition of a book first published in 1897. Since the publication of the first edition, the gas engine has undergone a remarkable development, not only for the automobile and aeroplane but for the general power field. While the demands of the automobile and aeroplane accelerated the improvements in design and efficiency of operation, the public recognition of the general usefulness of gas, gasoline and oil engines for all stationary and marine power requirements has stimulated improvements in these lines also. The minds of many inventors and designers have been at work, and a revised edition of the work became necessary because of the many changes that have taken place. The work deals with the history of the internal combustion engine; the theory of the gas and gasoline engine; utilization of heat and its efficiency in explosive motors; retarded combustion, wall cooling and compression efficiencies; compression in ex-

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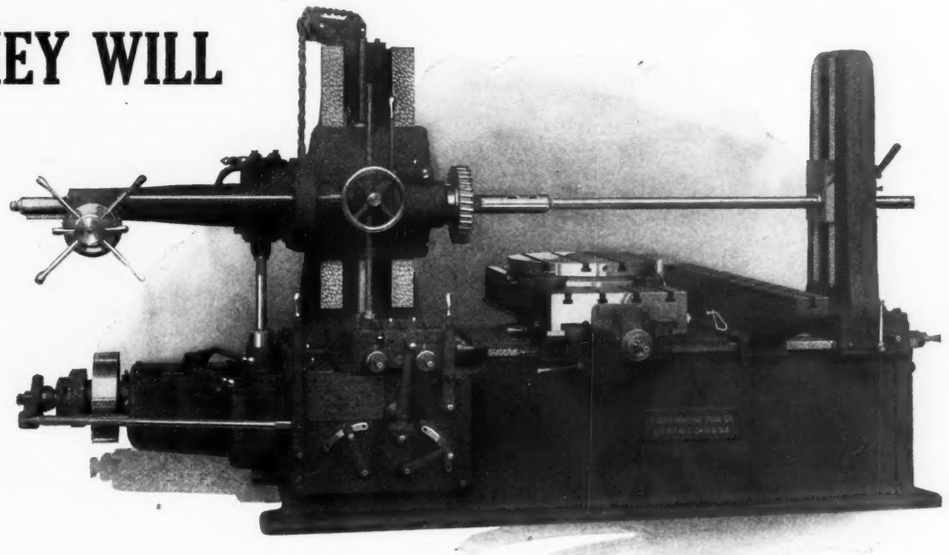

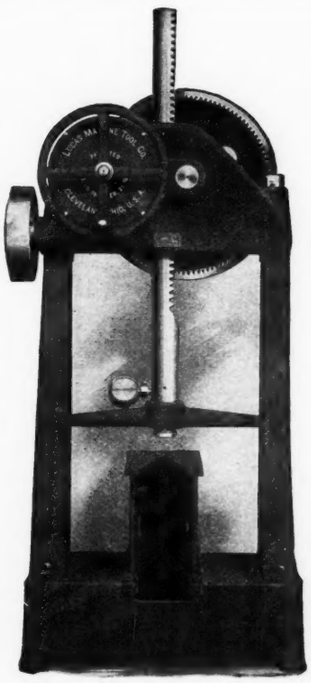

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More *different kinds* of work *gravitate to this press* than to any other machine in our own shop, and *our customers say the same.*

## LUCAS MACHINE TOOL CO., NOW AND ALWAYS OF CLEVELAND, O., U.S.A.

**AGENTS:** C. W. Burton, Griffiths & Co., London. Alfred H. Schutte, Cologne, Berlin, Brussels, Paris, Milan, Petrograd, Barcelona, Bilbao. Donauwerk Ernst Krause & Co., Vienna, Budapest, Prague. Andrews & George, Yokohama, Japan. Williams & Wilson, Montreal, Canada. H. W. Petrie, Ltd., Toronto, Ont.

plosive motors and its value; the materials of power in explosive engines; vaporizers, mixing valves and carbureters; cylinder capacity of gas and gasoline engines; governors and valve gears; explosive motor ignition; cylinder lubrication, cooling and exhaust silencers; construction details and parts of large engines; the measurement of power; explosive motor management and installation; types and details of stationary explosion motors; marine motors; kerosene, distillate and crude oil motors; farm motors, gas tractor power plants, electric lighting plants; design and application of automobile and motorcycle power plant parts; internal combustion motors for aerial navigation; producer gas and its production. The book is well printed on a good quality of paper and clearly illustrated. It is recommended to all looking for an elementary and comprehensive treatise on the internal combustion engine in its many forms.

**Scientific Management.** By Clarence B. Thompson. 878 pages, 6 by 9 inches. Published by Harvard University Press, Cambridge, Mass. Price, $4.

In presenting this work, Dr. Thompson has done a valuable service to all interested in scientific management of industrial organizations. The work consists of a collection of the more significant articles on the Taylor system of management, and a bibliography of all important papers presented before engineering societies and articles published in the technical press. The articles treat of practically every developed phase of scientific management in a thorough and comprehensive manner. The bibliography, including all articles published in the technical press, of course, makes it easy for the student to study all that has been published. The titles of the chapters are as follows: The Literature of Scientific Management; Industrial Administration and Scientific Management; Unsystematized, Systematized and Scientific Management; Science of Management; Present State of the Art of Industrial Management; Management Principles and the Consulting Engineer; Scientific Management in Business; A History of the Introduction of a System of Shop Management; An Object Lesson in Efficiency; On the Art of Cutting Metals; Prerequisites to the Introduction of Scientific Management; The Spirit in which Scientific Management should be Approached; The Successful Operation of a System of Scientific Management; The Planning Department, Its Organization and Function; The Foreman's Place in Scientific Management; Slide Rules for the Machine Shop as a Part of the Taylor System of Management; A Graphical Daily Balance in Manufacture; The Tool-room Under Scientific Management; Nomenclature of Machine Details; Classification and Symbolization; Elementary Time Study as a Part of the Taylor System of Scientific Management; Scientific Management in Retailing; Scientific Management in the Operation of Railroads; The Application of Scientific Management to a Railway Shop; The Railways and Scientific Management; The Mistakes of the Efficiency Men; Scientific Management; A Piece Rate System—Being a Step Toward Partial Solution of the Labor Problem; Wages and Wage Systems as Incentives; Relation of Scientific Management to the Wage Problem; Scientific Management and the Wage Earner; Another Side of Efficiency Engineering; The Taylor System of Shop Management at the Watertown Arsenal; Scientific Management as applied to Women's Work; Scientific Management as Viewed from the Workman's Standpoint; Preface to the French Edition of "The Principles of Scientific Management," by F. W. Taylor; Bibliography of Scientific Management. The chapters are contributions by men who have made a careful study of their subjects and thus a symposium is presented of the very best material available.

## NEW CATALOGUES AND CIRCULARS

**McCaffrey File Co.**, Philadelphia, Pa. Circular of files and rasps.

**Universal Machine Co.**, Bowling Green, Ohio. Circular of adjustable universal joints.

**Bock Bearing Co.**, Toledo, Ohio. Catalogue of the Bock taper roller bearing for both radial and thrust loads.

**Standish Tool Works, Inc.**, Standish, Me. Circular of the "Duplex" drill sockets and double-ended drills for use in same.

**D. J. Kelsey, 411 Y. M. C. A. Bldg., New Haven, Conn.** Circular of a new 7-inch and 8-inch combination angle protractor.

**Sprague Electric Works of General Electric Co.**, 527 W. 34th St., New York City. Leaflet 906 on electric hoists for the efficient handling of all loads.

**Armstrong Cork & Insulation Co.**, Pittsburg, Pa. Pamphlet entitled, "Saving Fuel," descriptive of "Nonpareil" insulating brick for boiler settings.

**E. Horton & Son Co.**, Windsor Locks, Conn. Leaflet supplementary to catalogue 12-C, describing and giving price lists of Horton solid body geared scroll chucks.

**Joseph Dixon Crucible Co., Jersey City, N. J.** Supplement to "Graphite," describing the steel fence paint tests made at Atlantic City, N. J., and giving results of the tests.

**Waxement Co., Inc.**, 51 Chambers St., New York City. Circular of "Waxement," describing a material and process for making concrete floors dustless, non-absorbent and stain-proof.

**Northern Engineering Works**, Detroit, Mich. Pamphlet on Northern Type E electric cranes and trolleys. Special attention has been given to safety provisions on these machines.

**Kempsmith Mfg. Co.**, Milwaukee, Wis. Leaflet descriptive of 6¼-inch triple index centers for use when cutting ratchets, small spur gears and similar work that must be mounted on arbors.

**Monarch Pneumatic Tool Co.**, East St. Louis, Ill. Bulletin 18-A on Monarch pneumatic tools, comprising drills, wood borers, long-stroke riveters, rivet busters, chipping hammers, holders-on, etc.

**Baird Machine Co.**, Bridgeport, Conn. Bulletin 208 Series C, describing Baird eyelet machines or multiple plunger power presses, and giving specifications for presses with six, four, five and eight plungers.

**Hauck Mfg. Co.**, 140 Livingston St., Brooklyn, N. Y. Circular of the Hauck kerosene torch for linemen and electricians. The torch is similar in design to the ordinary gasoline torch but uses kerosene as fuel.

**Link-Belt Co.**, Chicago, Ill. Catalogue 24 on Link-Belt steel chains and sprocket wheels. The chains are listed in the order of their strengths, and useful information relating to size and construction is conveniently tabulated.

**Sprague Electric Works of General Electric Co.**, 527 W. 34th St., New York City. Bulletin 48701, superseding bulletin 112, on Sprague electric dynamometers built in all sizes from 1 H. P. to 200 H. P. and for speeds up to 3500 R. P. M.

**Lehigh Car, Wheel & Axle Works, Catasauqua, Pa.** Catalogue 50 and price list of face-hardened sprocket and traction wheels; also square tooth and spiral jaw clutches, spur and bevel gears, tube mill linings, repair parts of crushing machinery, etc.

**New Britain Machine Co.**, 64 Bigelow St., New Britain, Conn. Circular of the New Britain ball bearing buffing lathe, belt-driven from beneath. The lathe is so designed that the belt is enclosed within the column, and no moving parts except the spindle are exposed.

**Keller Mechanical Engraving Co.**, 70 Washington St., Brooklyn, N. Y. Pamphlet on Keller automatic profiling machine for engraving on the profiling principle in steel, iron, brass, etc. A number of impressions from dies cut on the automatic profiling machine are shown.

**Sprague Electric Works of General Electric Co.**, 527 W. 34th St., New York City. Bulletin 48700 giving specifications, dimensions and weights of Sprague electric monorail cranes and showing a number of installations. Special machines are manufactured to meet individual requirements.

**Crescent Tool Co.**, Jamestown, N. Y. Catalogue 11, illustrating the "Crescent" line of drop-forged tools, comprising wrenches and pliers. The new tools added to the line are the 18-inch wrench, page 7; the 5- and 6-inch motor kit plier, page 13; and the 5-inch "Cee-Tee-Co" plier, page 14.

**Van Dorn & Dutton Co.**, Cleveland, Ohio. Wall hanger showing evolution in street cars from 1850 to 1914; also illustrating "V. D. & D." motor gears and pinions for street car motor drive. The hanger, sent to any address on request, carries a calendar for the last three months of the year 1914.

**Excelsior Pulley Co., Inc.**, Cuba, N. Y. Circular and price list of "Excelsior Premier" wood pulleys made at present 3 to 12 inches face and 4 to 14 inches diameter. These tools are provided with transverse grooves in the periphery to allow the escape of air entrapped between the belt and pulley face.

**Link-Belt Co.**, Chicago, Ill. New catalogue 158 on locomotive cranes, illustrated with photographs showing these cranes in actual use on a large number of different jobs. Some of the views show the machines unloading logs, storing lumber, storing coal, switching cars, handling pig iron with magnet, unloading sand, digging gravel, excavating land, etc.

**Bunting Brass & Bronze Co.**, 748 Spencer St., Toledo, Ohio. Price-list of Bunting's phosphor-bronze shaft bearing bushings from ½ inch outside diameter, ¼ inch inside diameter and ½ inch in length to 3⅜ inches outside diameter, 3 inches inside diameter and 5 inches in length. The prices given for lots of 100, 200, 500 and 1000 apply to plain sleeve bushings only.

**Roth Bros. & Co.**, Adams and Loomis Sts., Chicago, Ill. Bulletin 156 on electric polishing and grinding machines of the floor stand or column type. The motors of these machines are of unusually small diameter, giving the operator a large working arc without interference with the motor, the machines being comparable in this respect to ordinary belt-driven machines.

**General Electric Co.**, Schenectady, N. Y. Bulletin 42800, containing a reprint of an article on electrically driven air compressors in foundries. The article shows the advantages of the centrifugal compressor for this class of work. Bulletin 46390, describing the Thomson direct-current test meter, Type CB-5. Bulletin 48014 on mine hoist equipments, treating of the economy of electric drive as applied to underground hoists.

**Coffin Valve Co.**, Boston, Mass. Catalogue on valves, including sluice gates, gate valves, butterfly valves, check valves, flap valves, foot valves, shear and slide gates, automatic regulators, fire hydrants and other devices for the control of water. Interesting information is given on determining the size of valve required, and tables give the discharge and loss of head for Coffin rectangular sluice valves and Coffin circular sluice valves.

**Wallace Barnes Co.**, South and Parallel Sts., Bristol, Conn. Booklet 6 illustrating "Barnes-made" springs, which include special flat springs, spring washers, drop-forged and milled springs, flat coil and motor springs, wire springs, and a large number of special springs. "Barnes-made" screw machine products are also illustrated, and tables of decimal equivalents, weights of flat steel, wire gages and size, weight and length of wire, etc., are included.

**Keller Mechanical Engraving Co.**, 70 Washington St., Brooklyn, N. Y. Pamphlet descriptive of Keller die-cutting machines for dies, molds, rolls, hubs, etc. These machines operate on the profiling principle, in which a pattern or model is automatically reproduced. An idea of the variety of articles produced from the dies and molds cut on these machines can be obtained from the illustrations. Some of the work shown is silverware, jewelry, medals, cutlery, arms and ammunition, brass goods, letters and type, drop-forgings, molds for soft metal, glassware, etc.

**Burd High Compression Ring Co.**, Rockford, Ill. Pamphlet entitled, "A Few Facts About Piston Rings—Their Relation and Importance," containing a reprint of an article published in the "Scientific American" under the title, "How the Efficiency of a Motor Car is dependent upon Gas-tight Ring Joints." The pamphlet calls attention to the fact that the Burd high-compression ring fulfills the efficiency requirements laid down in the article referred to. Special emphasis is laid on the tight joint provided in these rings, making leakage of oil or gas impossible.

**Hendey Machine Co.**, Torrington, Conn. Catalogue of Lincoln type milling machines which are used extensively in the manufacture of rifles, revolvers, sewing machines, typewriters, adding machines, etc. The line of machines made by the company comprises many sizes and models, developed for specific lines of manufacturing from the lightest to the heaviest work commonly done on this type of milling machine. The catalogue contains 73 pages, 6 by 9 inches, and is profusely illustrated. It should be found interesting by everyone concerned with this class of machine work or whose work can be done advantageously on such machines.

**Cutler-Hammer Mfg. Co.**, Milwaukee, Wis. Bulletins 4500, 4510, 4520 and 4530 describing the new Cutler-Hammer line of automatic machine tool controllers for use with shunt or compound-wound, direct-current motors, adapted for constant or adjustable speeds, with or without interpoles. Increased output and lower cost of production is claimed for this automatic control, owing to the fact that the operator can start and stop the machine without leaving his normal position, and the possibility of the foreman setting the control at the proper speed for a job. The operator is free to start and stop but is unable to change the speed. The dynamic brake stops the machine immediately, as the motor acts as a generator when the controller is shut off.

**Ingersoll-Rand Co.**, 11 Broadway, New York City. Bulletin 4033 on "Little Tugger" air hoist for mines, contractors, manufacturing and power plants. Bulletin 8013 illustrating and describing "Little David" pneumatic chipping, calking and scaling hammers, made in seven sizes; the five larger sizes are for heavy work, while the two smaller are for very light chipping and scaling. Bulletin 8207, superseding bulletin 8107, treating of "Little David" pneumatic drills for metal and wood boring. The "Little David" drill is completely described, the various parts being shown in detail and different sizes of the reversible and non-reversible types being illustrated. This drill contains few parts and these are readily accessible. Convenience in handling and ready control are especially provided for.

**Springfield Machine Tool Co.**, 631 Southern Ave., Springfield, Ohio. New catalogue H on high-grade lathes and shapers. 64 pages, 6 by 9 inches. Springfield lathes are made in two general types, the first having the "Ideal" change-gear system with reversing mechanism for both lead-screw and feed-rod, and the second having the "standard" gear system in which the rapid screw-cutting mechanism is omitted. The latter is adapted for a manufacturing lathe rather than for tool-room use. The various parts of these lathes are illustrated in detail and general views of the different types are shown. An idea of the extensive line manufactured will be obtained from a partial list of the machines illustrated: "Ideal" geared-head engine lathe; "Ideal" engine lathe with five-step cone; heavy-pattern engine lathes; standard engine lathe with double back-gears; single pulley drive lathe; engine lathes with turret; spindle and axle boring machine; and motor-driven engine lathes. The line of shapers made by this company is also illustrated. The excellent half-tone illustrations and general typographical appearance of the book, as well as the concise descriptions, show evidence of considerable care in preparation.

**Brown & Sharpe Mfg. Co.**, Providence, R. I., is issuing a booklet on health and safety intended primarily for its own employes, but the material will be found to contain many valuable hints for the general reader on the prevention of accidents and the preservation of health. The first part of the book gives rules for the prevention of commonplace accidents, such as those resulting from wearing torn sleeves, loose neckties or other loose parts of clothing, disregarding the use of guards on moving parts of machinery, etc. The accidents in the Brown & Sharpe works during 1913 resulting from being caught in or injured by machinery were 23 per cent of the total number of accidents, and those resulting from injuries not due to machinery or lack of guarding, such as the workman's falling or objects falling on the workman, flying chips, cuts, jams, etc., were 77 per cent. This would seem to indicate that the majority of accidents are due to the negligence of the

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We can give you some interesting figures on a strictly first class rolled thread product, especially interesting if you buy in quantities of not less than a thousand gross at a time.

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**and please mention MACHINERY**

## Hammacher, Schlemmer & Co.

**Hardware, Tools and Supplies**

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workmen, and with a little care could easily be prevented. Under the health hints, information is given on the body as a machine, the human eye, healing of wounds, blood poisoning, treatment of burns, strains, sprains, rupture, varicose veins, boils, appendicitis, teeth, indigestion, colds, consumption and headache. The book closes with a caution against the use of cigarettes and alcoholic drinks.

## TRADE NOTES

**Walter B. Snow**, Boston, Mass., publicity engineer, has moved his offices to rooms 511-516 in the new Federal St. Bldg., 136 Federal St.

**Triumph Electric Co.**, Cincinnati, Ohio, has opened a new office in New York City at 114 Liberty St. The office is in charge of W. B. Elliott.

**C. E. Fales Machinery Co.**, Detroit, Mich., has removed to the Kerr Machinery Bldg., Beaubien and E. Fort Sts., where a complete line of new and second-hand metal-working machinery will be carried in stock.

**Fairley-Davidson Steel Co., Inc.**, 124 Maiden Lane, New York City, was recently organized to sell the steel product of James Fairley & Sons Co., of Birmingham and Sheffield, England. A. C. Davidson is president and treasurer of the concern.

**Union Twist Drill Co.**, Athol, Mass., is building an addition to its steel treating department, 30 by 173 feet, one story high, to afford better facilities for annealing and general blacksmith work. A brick and cement addition to the cutter department is also being erected, 62 by 115 feet, three stories high.

**Link-Belt Co.**, Chicago, Ill., has received an order from the Navy Department of the U. S. Government for four steam-operated revolving locomotive cranes. Three of these cranes will be installed at the Philadelphia Navy Yard and the fourth at Charleston, Md. The locomotive cranes are of the company's eight-wheel type with slight modifications made to conform with the government specifications.

**Independent Pneumatic Tool Co.**, Chicago, Ill., manufacturer of "Thor" pneumatic tools and electric drills, has appointed V. W. Robinson its representative in Michigan with headquarters at Detroit. **F. J. Passino**, the Michigan representative of the company, has been appointed representative in the Southwest to succeed H. F. Finney, promoted to a position in the general sales office in Chicago.

**Fafnir Bearing Co.**, New Britain, Conn., manufacturer of ball bearings, announces that the selling arrangement existing between it and the Rhineland Machine Works Co., New York City, has been discontinued and that hereafter Fafnir ball bearings will be marketed direct from the factory at New Britain. D. D. Davis, formerly of the Rhineland Machine Works Co., will be in charge of the new sales organization.

**Butterfield & Co., Inc.**, Derby Line, Vt., are placing on the market a new screw plate designated as the "combined automobile screw plate." This plate contains taps and dies, cutting the S. A. E. standard and also the regular V-thread or U. S. standard. The repair and garage man particularly should appreciate the advantage of having these two forms of thread in one set. These plates are made in the well-known "Derby" style and in sizes cutting from ¼ to 1 inch.

**Rhineland Machine Works Co.**, 1737 Broadway, New York City, announces that in addition to the large stock of imported bearings from its French and German factories now on hand, its American factory is in a position to supply orders. The American plant has been in operation for the past four years, making the same grade of ball bearings as those imported. The company has a large supply of imported steel and balls in nearly all sizes, the stock being sufficient to last from six to twelve months.

**Hess-Bright Mfg. Co.**, Front St. and Erie Ave., Philadelphia, Pa., has issued an announcement in regard to its supply of Hess-Bright ball bearings. When communication with the Berlin factory was interrupted, the company had approximately 500,000 bearings in stock. With a few exceptions, the stock was well balanced, and provision has been made for supplying these so that customers will be taken care of. Manufacturing facilities are being increased as rapidly as possible, consistent with the production of first quality goods.

**Crocker-Wheeler Co.**, Ampere, N. J., recently completed and shipped an order for four generators to be used in the Ford factory in Detroit, Mich. These generators were of such great size that they had to be shipped in parts and assembled in Detroit. About fifteen cars were required to accommodate them. Each generator has a normal capacity of 3750 K. W. and weighs 105 tons. The field frames are 21 feet high and 26 feet wide across supporting feet. The armature is approximately 16 feet in diameter and weighs 87,000 pounds.

**Harding Mfg. Co.**, Mansfield, Mass., has been organized to manufacture the Martell aligning reamer formerly sold by the Martell Motor Co., Boston, Mass. This reamer was designed for reaming the crankshaft bearings of automobile engines, its construction and use being such that perfect alignment is assured. A. A. Martell, the factory manager, was for several years head of the experimental and testing departments of the Packard Motor Car Co., Detroit, Mich., and later in charge of the company's Boston agency. Harry B. Sargent of Mansfield is the office manager and secretary.

**Mesta Machine Co.**, Pittsburg, Pa., is building two gas blowing engines of 46- and 84-inch cylinder diameters by 60 inches stroke, for the Pennsylvania Steel Co., Steelton, Pa. These engines are believed to be the largest gas blowing engines ever built in America. The gas cylinder and the blowing cylinder are arranged in tandem, an innovation in the United States but common in European practice. Another innovation so far as American gas engine practice is concerned is the use of a center crank instead of an overhung crank. The blowing tub is equipped with Mesta automatic plate valves first used in 1911.

**Gisholt Machine Co.**, Madison, Wis., has appointed J. L. Osgood of Buffalo, its agent in the Buffalo and Rochester territory. R. D. Heflin, who has heretofore represented the Gisholt Machine Co. in the New England territory and who made his home at Hartford, Conn., is now in charge of the company's New York office. He will look after Gisholt business, not only in the New York territory but in the New England territory as well. Ellis F. Muther, formerly Eastern sales manager with headquarters in New York City, has been appointed general sales manager in charge of the general sales and advertising work and will make his headquarters at the Madison, Wis., office.

# Classified Advertisements—Situations, Help Wanted, For Sale, etc.

**Advertisements in this column, 20 cents a line, seven words to a line. The money should be sent with the order. Answers addressed to our care will be forwarded. Original letters of recommendation should not be enclosed to unknown correspondents.**

### HELP WANTED

SUPERINTENDENT.—Thoroughly capable, experienced man. Only one who knows gasoline engines, pumps, implements, etc. State experience; salary desired; age; history. Mail references in reply. None but the best considered. Box 678, care MACHINERY, 140 Lafayette St., New York.

MACHINE DESIGNER, about thirty, with experience in automatic envelope and paper bag machinery and allied lines, wanted by old established paper working company, developing and building a line of special machinery. PERMANENT, Box 680, care MACHINERY, 140 Lafayette St., New York.

AGENTS.—Sell Lettering Angles, which are improved triangles. Principal improvement is tapered holes for scoring accurately spaced guide lines for lettering. Retail prices 60 cents to $1.05. Easy to interest Engineers, Architects, Draftsmen, Tracers and Sign Painters. A recommendation from instructors enables agents to sell large quantities to students, who are the largest buyers. Send for pamphlets and terms. BRADDOCK INSTRUMENT CO., Swissvale, Pa.

WANTED AGENTS.—Saunders' Pocket "Hand Book of Practical Mechanics" for tool chest $1.00 only. Why pay more? It fills bill for shop kinks, ready reference, simple arithmetic. Send for circular. E. H. SAUNDERS, 216 Purchase St., Boston, Mass.

### SITUATIONS WANTED

MECHANICAL DRAFTSMAN; experienced; good references. Box 681, care MACHINERY, 140 Lafayette St., New York.

SUPERINTENDENT, chief draftsman or other factory executive by Electrical Engineer (Cornell) with fifteen years' experience in the development, design and manufacture of mechanical and electrical inventions, special apparatus, instruments, etc. Box 679, care MACHINERY, 140 Lafayette St., New York.

MECHANICAL ENGINEER.—University graduate; age 28; single; experienced in gas and Diesel engines and centrifugal pumps; competent draftsman; speaks German, Spanish and some English; modest respecting salary; location immaterial. Box 682, care MACHINERY, 140 Lafayette St., New York.

MECHANICAL ENGINEER.—Designing, Consulting and Experimental. Experienced in tractors, harvesting machinery, gas engines, automobiles, etc., desires communication with any reliable concern relative to a responsible position. Box 684, care MACHINERY, 140 Lafayette St., New York.

FOREMAN for automatic and hand screw machines. Practical experience on Brown & Sharpe, Acme and Gridley automatics, also hand screw machines and chucking machines. Thorough experience in tooling and the cost of production. Box 686, care MACHINERY, 140 Lafayette St., New York.

### FOR SALE

FOR SALE.—18 x 42 Greenwald-Brown Automatic Steam Engine, first-class condition. 24" x 14' fly-wheel. THE HAUSER-STANDER TANK COMPANY, Cincinnati, Ohio.

FOR SALE.—50 LINCOLN MILLERS $50.00 EACH, just as taken from the factory. Send for photo and description. J. L. LUCAS & SON, Bridgeport, Conn.

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